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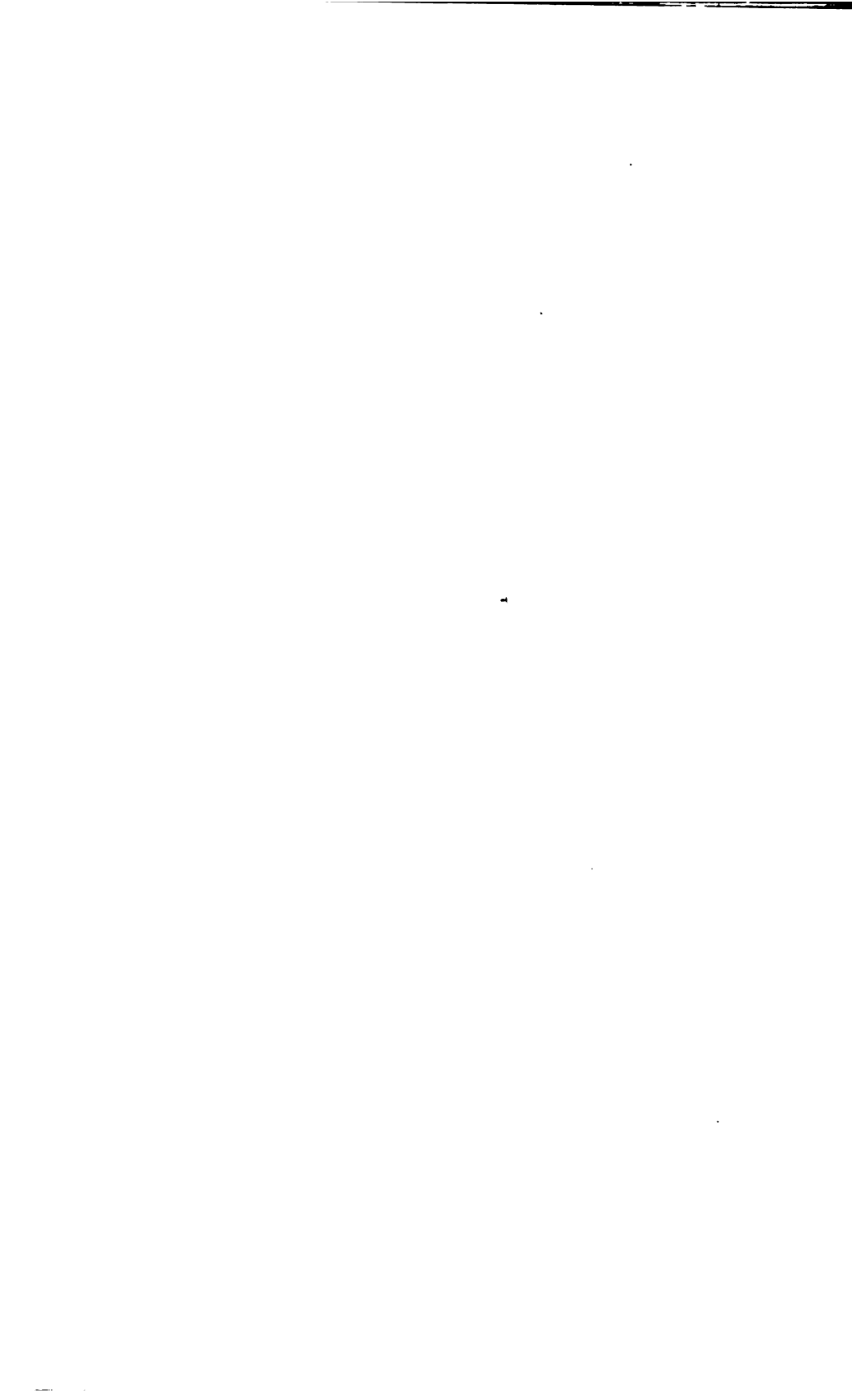


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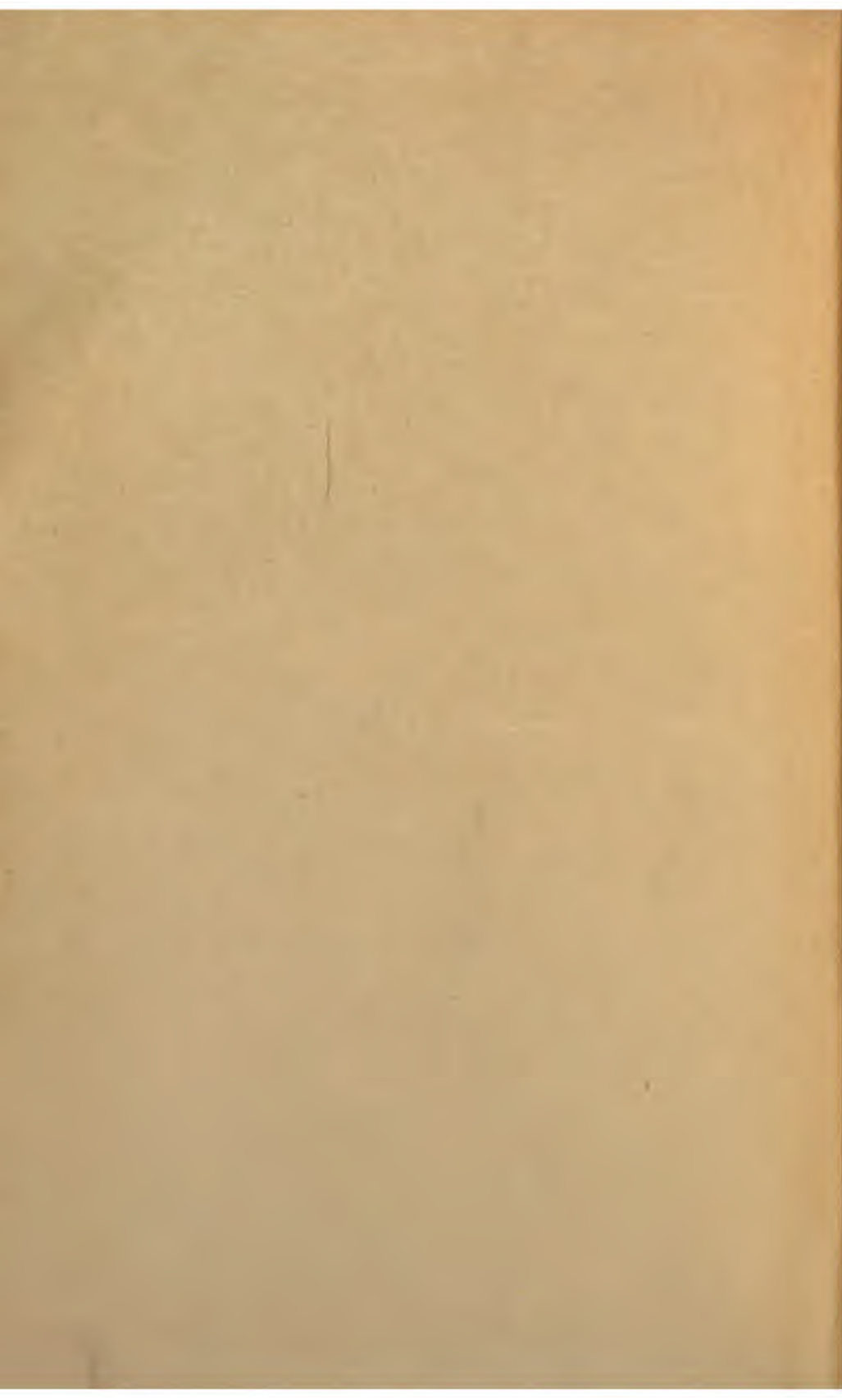
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11,983

Bulletin 61

ECONOMIC GEOLOGY 11

QUARRIES OF
BLUESTONE AND OTHER SANDSTONESIN THE
UPPER DEVONIAN OF NEW YORK STATE

BY

HAROLD T. DICKINSON

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Bulletin 61

ECONOMIC GEOLOGY II

QUARRIES OF BLUESTONE AND OTHER SANDSTONES IN THE UPPER DEVONIAN OF NEW YORK STATE

PREFACE

The first official study of the building stones of New York was made by Dr James Hall, state geologist, in preparation for a report to the commissioners of the new state capitol in 1868. His examination of the building stones available for this great building led to the formation of a collection of large cubes dressed on different sides to show various modes of treatment, which is now the nucleus of a large collection in the Geological hall.

In 1886 Prof. John C. Smock took up the study of the building stones of New York and in bulletins 3 and 10 of the New York state museum, contributed copiously to our accurate knowledge of the resources of New York state in this sort of building material.

With the lapse of time it becomes necessary to enlarge our descriptions and records and it is now proposed to bring up to date our knowledge of the subject of building stones.

This has, however, grown to such an extent that it seems hopeless to treat it all in one volume or publication. It is intended, therefore, to issue, as time and means will permit, separate bulletins discussing various types of this important material. The first contribution is the following one on that valuable and important variety of sandstone known as bluestone and on rocks of allied character.


FREDERICK J. H. MERRILL

July 1902

INTRODUCTION

The area in New York in which are quarried the sandstones of the Upper Devonian, as shown by the accompanying map, is bounded on the east by a line roughly parallel to the Hudson river and from 5 to 30 miles west of it, beginning in Albany county and running south to West Hurley in Ulster county, where it turns to the southwest, following Rondout creek. The northern boundary of these formations is approximately in an east and west line 15 to 20 miles south of the Mohawk valley and stretching westward to the shore of Lake Erie, which is the western limit. The whole of the central and southern part of New York state is occupied by these sedimentary rocks, the formations extending south into Pennsylvania. The sandstone is quarried at different localities throughout the whole territory, the most productive region being the southeastern part, where numerous quarries have been opened in the eastern face of the Catskill mountains, in the low lying terraces between the mountains and the Hudson river and in the hills on both sides of the Delaware river. This district is favorably situated for the transportation of the stone to the eastern markets and is the chief producer of the commercial "blue-stone" so extensively used for flagstone, street crossings and house trimmings in the larger cities of the east.

The beds occur from the Hamilton group to and including the Catskill and are horizontal or dip at gentle angles. The greatest difference in elevation between the workable beds is shown in Ulster county, where a few of the mountain quarries are 2500 feet above the quarries nearest the Hudson river. The rocks are shales and sandstones. But there is so great a range in composition and texture that there are many varieties under each of these heads and an almost infinite gradation from one to another, and no sharp line can be drawn. The quarry stone is, as a rule, even bedded and compact and can be split in planes parallel to the bedding. In texture the stone



varies from the exceedingly fine grained material which takes a very even finish, to a sandstone which is almost conglomeritic in its nature. The color is highly variable, being blue, gray, greenish, pink and red in different localities.

Four geologic groups are represented in this territory, viz, Hamilton, Portage, Chemung and Catskill, but the distinctions between these groups are in part paleontologic and may be disregarded in a discussion of the economic geology of the area.

The main belt of country producing the even bedded and compact sandstone suitable for flagging and house trimmings known commercially as "bluestone" begins on the western side of the Hudson river in the southwestern part of Albany county and stretches southward through Greene, Ulster, Sullivan, Delaware and as far west as Broome county.

Besides this main belt there are scattered localities in the central part of the state, producing bluestone, at Oneonta, Rock Rift, Oxford, King's Ferry, Trumansburg and Portageville.

The district including Greene, Ulster, Delaware, Sullivan and Broome counties is the most productive, the products reaching the markets by the way of the Hudson river, and Erie and Ontario and Western railroads. The quarries in this district are all small and as a rule short lived.

The term bluestone was originally applied to the blue colored sandstone quarried in Ulster county, 4 to 7 miles west of the Hudson river. Today in commerce, the name bluestone is applied to a large part of the flagstone produced in the state, regardless of color. It is therefore, today rather a misnomer, for this material is sometimes green and occasionally reddish.

Probably 75% of the Ulster county stone is marketed in the condition known as "quarry dressed," the balance being treated in the mills along the Hudson river.

In Broome, Delaware and Sullivan counties a very small percentage of the product passes through mills in the district. Some "rock" however is shipped in the rough to other mills.

A large part of the stone at Oxford, Portageville and Rock Rift is subjected to mill treatment.

There are three classes of the product of the quarries, 1) flagstone, 2) "edge" stone and 3) "rock." The first class includes the stone used for sidewalks and requires little dressing. A stone $1\frac{1}{2}$ inches thick and over, with a smooth surface and edges at right angles, fulfils all requirements. Bluestone is particularly suitable for use as flagging, retaining after long wear its rough surface. "The stone is so compact as to absorb but little moisture, and thus, when used as flagging, ice and rain remain upon it but a short time." "Its hardness resists wear, never forming the slipping surfaces of clay slate."

The second class includes such stone as curb, window and door sills, lintels and other house trimmings. This stone all requires dressing; curb requires "axing" on the face and edge. This class of stone requires one or more perfect edges for market.

The third class includes the stone sold in the rough to the dealers for mill treatment. All this is thick stone, varying from 4 inches to 5 and 6 feet. It is sawed or planed in the mills for platforms, steps and building stone.

The products of the first two classes are often treated in the mill when orders call for such finished work.

The kinds of stone as to shape, size and use are more numerous than the uninitiated would imagine.

As regards the microscopic structure and quality of the stone, the following notes by F. L. Nason¹ are interesting.

Bluestone. Bigelow bluestone co. (now Ulster bluestone co.) Minerals: quartz and feldspar. The quartz is in grains, which appear to be very angular in shape, more like a breccia. The grains are clearer than those of other sandstones examined, and the proportion of quartz grains to the rest of the matter is smaller. The feldspar observed differs very materially from that in the other stone. Grains of triclinic feldspar are observed, which are very fresh. Another feldspar is almost completely decomposed. No carbonate of lime appears to be present, and very little oxid of iron. The long, wavy, crystallike dark spots in the stone appear to be decomposed feld-

¹N. Y. state mus. 47th an. rep't 1893. 1894. p.583; N. Y. state geol. 13th an. rep't 1893. 1894. p.389.

spar, more or less stained with iron. The cementing material is probably silica, as dilute hydrochloric acid has no effect, and it is not stained with iron.¹

Joints and bedding

The beds of stone are divided naturally by vertical joints at right angles, one system running about north and south, while the other has an east and west direction. The north and south joints are known to the quarrymen as "side seams," while the east and west joints are called "heads," "head-offs" or "headers." These joints are persistent throughout the whole area of the two main districts, but in Delaware and Broome counties the east and west joints are likely to be very irregular. The distance between these joints determines the maximum size of the blocks, but not often is a stone the full size of the block taken up. These joints are from 5 feet to 75 feet apart as a rule. The bed is divided also by horizontal seams which are at varying distances apart. These layers are known as "lifts."

In addition to these open seams and between them, occur what are known as "reeds." The reeds are really closed seams which can be seen on looking closely at the edge of a block. The reeds are both an advantage and a disadvantage. They occur, as a rule, in only the fine grained stone. They are advantageous in that they provide means of splitting a thick stone into a number of thinner ones. This splitting is done by means of a "point" and thin wedges. They are a disadvantage in that they are a source of weakness in the stone. The frost will often open up the reeds, specially in curb which is set on edge. Each quarry has its characteristic reeds. A typical "black reed" is the best for splitting stone.

It is often true of these reeds that, after quarrying, when the stone is exposed to the weather two or three weeks before

¹The test was as follows. A thin slice of the stone, $\frac{1}{16}$ of an inch thick was immersed in the dilute acid. In the case of a calcareous sandstone, or of a ferruginous sandstone, the grains of silica and feldspar would have been loosened into sand. The slice of rock remained practically unaffected.

frost, they tighten and close up, while, if it is quarried during the winter, the reeds will open. Again, it is true that, with a thick lift, if the stone is split to a thickness of 6 inches, there is no danger of the reeds opening, while, if it is left thicker than this, the danger of the reeds opening from exposure is great. Some reeds will not open at all, even when the block is "pointed" all around, and others will open only partly. As before stated, each quarry has its characteristic reeds, which have to be found by the quarrymen by experience.

The seams in the quarry are a source of trouble and at times loss. A seam will "shift and grow" or "double," that is, on the front edge of a block the thickness of a lift may be 2 inches while on the back the thickness will be 4 inches. Two seams have run together, not gradually, but by a sudden jump, leaving the two faces of the stone parallel. All these considerations affect the commercial value of a quarry.

When a quarry is first opened, the lifts are always thin, not over $\frac{3}{4}$ inch to 2 inches thick. As each tier of blocks is taken out, the lifts are thicker. Also it is a common occurrence to find that the lifts in the lower part of the bed are heavier than those at the top. All thin lifts are used as flagstone, while the thicker lifts are worked into edge stone or left in the rough and sold as "rock." As a rule, a good "rock" quarry is the most profitable, as the stone requires no dressing of any kind. But, on account of the sizes and weight of the stone, derricks are required.

Between the lifts, a thin bed of shale may occur, 3 to 4 inches thick. Shale is known to the quarrymen as "pencil." A "rough streak" in a quarry bed is a common occurrence. This is a streak of stone, of varying thickness, in which the seams are very irregular. There are varying degrees of "roughness"; part of the streak may be worked into salable stone, with extra labor, or it all may have to be dumped on the rubbish pile.

A bed of stone is said to be "bottomed" when a thick rough streak or pencil is encountered. A rough streak is not always permanent. With each new tier of blocks taken out, the con-

ditions change, and the rough streak may become as workable as the balance of the bed, and again it may increase in size, spoiling the bed entirely.

Nearly every quarry has its own peculiar formation. Quarries within 400 or 500 yards of each other frequently differ greatly as to quality and formation.

Stripping

The overburden, or "top," consists in Ulster county of a layer of soil, clay or hardpan, underneath this alternating beds of shale and rock. This "rock" is a name given to the part of the ledge which can not be worked into salable stone. ("Rock" also is a term applied to the thick "lifts" of stone which are sold to the mills for sawing and other treatment.) Below the shale and the rock is the bed of stone. The thickness of the soil, shale, rock and bed of stone is very variable. But a rough ratio for profitable quarrying is 1 of bed to from 2 to 3 of top, depending on the ease with which the stone is worked, its quality and the character of the bed. Some quarries have all soil top, some all rock, and again some have all shale top. Generally all three are found except in Delaware and Broome counties, where shale occurs rarely.

The stripping is usually carried on in winter, as only a few quarries can be worked when it is very cold, owing to the effect of freezing on the durability of the stone. The ground also is then frozen hard, and the scales of dirt are quite firmly cemented by frost. Dynamite or some other high explosive is used to loosen the rock and dirt. This is found to be better and more economical of time and labor, since the frozen dirt and slate can be handled better than when uncemented. The stripping is handled by shovels and wheelbarrows for the soil and shale, while powder and dynamite are employed in breaking up the rock. There is not much difference in cost of removing the various kinds of "top" except as to thickness. Rock is easily handled with a derrick after blasting. Hardpan requires considerable work even after blasting. Shale and soil require a great

deal of work in handling. A one horse dump cart or a small car and wooden or iron rails are often part of the equipment for stripping.

The waste material or rubbish is carted away and dumped opposite the face of the quarry. In the case of the quarries in the mountains, this rubbish is dumped down the mountain side. Very little attention has been paid to the proper disposal of this rubbish, for, in many cases, it has to be handled twice. In many beds which are now being worked in Ulster county the greatest part of the stripping is rubbish from quarries opened 40 years ago and abandoned.

Quarrying

Quarrying is carried on eight or nine months in the year. In many quarries no work at all is done during the winter. After the stripping is done, the different lifts are raised by wedges driven into the open seams, just enough to give the proper strain for the lift to free itself from the under bed. The area of these lifts varies with the size of the block. That of large ones may be 1000 square feet or more. The thickness varies from 1 inch to 8 feet.

If it is not possible to lift the layer from the whole block, a line is marked by cord and chalk where it is necessary to break the stone. This line is traced across with a point by digging out holes $\frac{3}{4}$ inch to 1 inch deep and from 2 inches to 3 inches apart. The point is held so that its horizontal projection will fall along the chalk line. After the block has been traced across, every sixth or seventh hole is drilled to a depth corresponding to the thickness of the lift. In these deeper holes, plugs and feathers are placed. The plugs are driven down together by striking one after another, so that the strain is equal all along the line. To do this well requires a great deal of skill, which is a result of long and close attention to work. At a certain point of strain the stone will break off along the chalk line, true and even. In Ulster county the stone breaks the best in a north and south

line following the side seam, while in Delaware and Broome counties the stone breaks best in an east and west direction. The quarrymen say that the stone "works" best north and south or east and west as the case may be. This same system is used in breaking lifts of large area to smaller sizes.

Generally, very little powder is used in blasting out the bed of the stone. The joints are usually free or open for working. When powder is necessary in the bed the "Knox" system of blasting is used, a short description of which follows. The holes are first drilled to the desired depth in a line then "reamed" out, making the hole elliptic in section, the longer axis being in the line of the holes. A small amount of explosive is put in each hole with little or no tamping. Within a foot or so of the top of the hole a plug is put in and the tamping placed on top of this. The holes are fired simultaneously by electricity. The greater part of the force of the explosion is taken up by the air cushion and, as a result, the block is not shattered or split.

In the larger quarries in Ulster county district, hand and horse power derricks are used, but in no case are there any steam hoists except at the docks. In Delaware and Broome counties there are a few steam derricks, and all the larger quarries are equipped with hand or horse power derricks. A blacksmith shop for sharpening and tempering tools is usually part of the equipment of all the quarries. The tools consist of hammers, points, drills, wedges, plugs and feathers, crowbars and shovels. In a very few instances does the equipment include steam drills or pumps.

When water is troublesome a siphon is used, if a sufficient fall can be had, or a horse or hand power pump is used when a siphon is not available. In the few cases in which the steam pump is used the "pulsometer" seems to be a favorite.

The following from *Stone* is of interest as showing the peculiarities of bluestone quarrying:

The quarrying of bluestone probably requires as much skill, if not more, than any other kind of stone, a fact often over-

looked and a potent factor in the success of a quarryman. It seems to be a general impression among a great many users and perhaps a few of the producers of this most useful and durable stone, that a man needs only to find a deposit of salable quality of bluestone, no more than usual proportion of top to bed, with the usual shipping facilities, and success is assured. But for any one who has been closely connected with this especially interesting business, it is easy to find the reason why a quarry has not paid. The causes are usually radical, and one of the first flaws after ascertaining that the quarry contains stone in fair quantity will be found by looking into the system of quarrying, and here is frequently a drawback to the prosperity of the quarry.

As a rule, the best quarrymen have worked in the quarries from the time they have been able to do anything, and, as that is usually pretty early in life, many of them have gained such knowledge of the work that they know to a certainty how the stone will work, as soon as they see the bed, without raising a lift. It is only after long work that a quarryman becomes expert.

Dressing

After the stone is lifted from the bed, it is handed over to the stonecutter, who prepares it for market. If it is flagstone, it is cut into commercial sizes 2, 3 or 4 feet wide, and the irregularities are chiseled down. Flag, as a rule, requires little dressing. If the stone is to be cut into curb or other "edge" stone, the block must be split, if too thick, and then broken to the proper width. Curb is usually "axed" 12 inches to 14 inches on the face, and the top edge is pitched at the proper angle. "Rock" and platform require no dressing in the quarry. The dressing of the stone in the quarry is usually of the roughest kind and is done as quickly as possible. For the finer grades of axed and cut stone, the work is done on the docks.

At many of the docks stone mills are in operation. The mill treatment consists of sawing large blocks, planing and rubbing the house trimmings, platforms, steps etc., and boring sewer heads.

There is a great difference in the stone in regard to its action under a saw or planer. Some stone will chip or check under a planer and not give the smooth surface desired, while other

stone will wear out the gang saws very fast. The action of a stone in a mill depends largely on its hardness and texture.

A planer consists of a stationary base with a moving carriage, on which the stone is placed and held firmly by set screws. This carriage moves forward and backward under the bits of the planer. These bits are fastened to the immovable part of the frame, and, as the stone passes under them, take off the irregularities of the surface.

A gang saw has a varying number of saws set at different or the same distances apart. These saws are fastened by wedges on a frame above the block of stone and are moved forward and back by an eccentric. As the cuts in the stone deepen, the frame is lowered by a feeding device. Sand and water are fed into the cuts during the sawing.

Rubbing is usually a secondary treatment to planing. The rubbing bed is a circular cast-iron plate, which revolves horizontally. The stone is placed on this and held stationary by projecting arms. The revolving cast-iron plate grinds the stone and smooths off the irregularities of planing. Sand and water are fed from the center into the bed during the process.

Another kind of saw is the "diamond" saw, which has diamonds set along the edge of the saw. The diamonds are held in cast-iron teeth, which are removable from the blade. There are 10 to 12 teeth, containing 2 to 3 "borts," in each saw, spaced equally, according to length of blade. The diamond saws cut 23" to 24" an hour, while the ordinary gang saw cuts only 2½" to 2¾" an hour.

Most docks have one or more stonecutters employed in special and fine work.

Rent and ownership

The majority of the quarries in the two main districts are worked by two or three men, sometimes in partnership, but often one man operates the quarry, hiring one or two extra men as quarrymen or stonecutters. A good stonecutter can command a wage of \$1.75 to \$2.25 a day, while a quarryman is paid \$1.50 to \$2, and in some places only \$1 a day. In Delaware and

Broome counties the demand for stonecutters is greater than the supply this year.

The quarrymen seldom own the land on which the quarry is situated, but lease it at a rental proportionate to the amount of stone taken out. In Ulster county the usual rental is 5% of the value of the stone quarried. In Delaware and Broome counties the rental varies from $\frac{1}{2}$ c to 1c a foot of the product, according to the location of the quarry. This "per foot" applies to the stone as sold, that is, if the stone is sold per linear foot, the rental is $\frac{1}{2}$ c per linear foot; if sold per square foot, the rental is $\frac{1}{2}$ c per square foot. This is hard on the flagstone quarries, as the price of flag ranges from 5c to 8c a square foot, but for quarries producing edge stone, the rental is much less, as curb is sold for 16c a foot. The charge of 5% appears to be a much fairer way of renting.

In Ulster county the larger quarries are in many cases owned by the dealers, but in only a few cases are the dealers operating the quarries. They prefer to rent them on a percentage basis. They own the ledges in order to control the output of the stone.

Transportation

The stone is hauled by two, three and four horse teams to the docks or railroad switches. Only at Rock Rift and Portageville do the railroad switches run into the quarries. In Ulster county very little stone is shipped by way of the Ulster and Delaware railroad from Broadhead's Bridge to Kingston. The freight rate is higher than the cost by wagon.

The wagons in use hold from 8 to 10 tons of rock. A great proportion of these wagons are now equipped with wide tires; in fact, some towns have local legislation requiring wide tires on wagons weighing over a certain amount. The main quarry roads are often "bridged" with bluestone. "Bridging" consists of thick stone laid as a track for the wheels of a wagon. This "bridge" is 20 inches wide and 4 inches to 6 inches thick. It does not take long for wagons to wear deep ruts in the bridge.

But, if kept in repair, these bridge roads are the best for the heavy quarry wagons. The quarries on the hills and mountains have a separate road leading to each from the main roads. As a rule, these are in fearful condition, being cut to pieces by the chained wheels. The grade of these roads is very steep. A 25% grade is not an uncommon one. An extra horse is often employed for hauling the stone wagons up to the quarry.

The loading of the stone on the wagons in the quarry is done by a derrick when possible. If there is no derrick in the quarry, the loading is done by hand. If there are a number of quarries near together, the different gangs assist one another in loading.

In coming down loaded, one or both of the rear wheels are chained or a shoe is used. In addition to this, the front wheels are equipped with foot brakes. The driving of these wagons down such steep grades is attended with much danger, and many fatal accidents occur. The drivers become very skilful in the work, but at times are careless. Carelessness in chaining wheels is often the cause of the most serious accidents. After the wagons reach the main roads, few steep grades are met. The unloading of the stone at the docks or switches is done usually with hand, horse or steam power derricks. The different sizes are piled at separate points on the docks and shipped as ordered.

The cost of transportation to the docks or shipping points is borne by the quarrymen. The cost is based on the value of the load, the distance between the quarry and the dock and the condition and grade of road. The cost runs as high as 50% of the value of the load and as low as from 8 to 10%. The latter cost is for quarries favorably situated in respect to the docks. Usually a team will make three and four trips a day between the dock and quarry, at this price. Quarries are often spoken of as "three trip" or "four trip" quarries, as the case may be. Only the larger quarries have their own teams, and the hauling is often conducted as a separate business from the quarrying of the stone.

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Market

The stone from the quarries is sold to the wholesale dealers, who make a business of collecting the stone and shipping it to the place of consumption. The stone is paid for by the load, or each week or month. Usually the cartage is deducted and paid directly to the teamster. Rent also is deducted from the value of each load, if the dealer owns the quarry ledge.

The stone is sold by the square and linear foot. Flagstone is always sold by the square foot, while curb and crosswalks are sold by the linear foot. What is known as "rock" (the thick large stone) is sold at so much an inch per square foot. That is, a stone 10 inches thick, 10 feet square at 2½c an inch, would sell for \$25.

At one time there was a combination of the dealers along the Hudson river to control prices; but this has been broken up now, and the competition between the buyers has resulted in a rise of prices paid to the quarrymen. The largest dealers along the Hudson river have New York or Philadelphia offices, which are selling agencies. Along the Erie and Ontario and Western railroad a few dealers combine and pay an equal share of the expense of a selling agency in one of the large cities. The stone from the Hudson river is sold mostly in New York and New England cities and villages. This stone is loaded on barges, which are towed to the different cities on the seacoast. The stone from Delaware and Broome counties is sold very little in New York city, the high cost of freight and lighterage prohibiting competition with Ulster county stone. This stone is sold in New York and inland towns, such as Binghamton, Elmira, Rochester, Johnstown, Syracuse, Utica. Some of the stone from this district goes to Philadelphia.

The time available for this investigation did not permit the author to visit the quarries of Albany county, consequently the quarry descriptions are not complete for the entire state. For Albany county see Nason, N. Y. state mus. 47th an. rep't, p. 457.

QUARRIES IN GREENE AND ULSTER COUNTIES

The main points where bluestone is quarried in these counties are Quarryville, Fish Creek, Highwoods, Dutch Settlement, Palenville, West Saugerties, Woodstock, Jockey hill, West Hurley, Stony Hollow, Lapala and Mackey hill.

Beginning on the north in Greene county and following a line roughly parallel to the Hudson, the first quarries in this district are 4 miles west of Catskill, those of Lane Bros., Lane & Bloom, Lane & Hood, and Herbert Bloom.

Lane Bros. Bed of stone is $7\frac{1}{2}$ feet thick, with 20 feet of rock and slate stripping. Stone is fine grained, very reedy and of good blue color. The bed is rough and dips south and west. Cross bedding is shown and some "rock" is interbedded with the stone. Lifts are 3" to 12" thick. Three to four men are employed nine months in the year. Product is principally curb and other edge stone, and is sold to Smith & Yeager at Catskill.

Herbert Bloom. Quarry is south of Lane Bros. and on same ledge, working only top bed of thin bedded flag 3 feet thick. One man is employed intermittently. The product is flag, and is sold to Smith & Yeager at Catskill.

William Lane & L. Hood. These work on this same ledge occasionally, and sell the product at Catskill to Smith & Yeager.

James Lane & Jacob Bloom. This quarry is situated a quarter of a mile north of Lane Bros., and is probably on the same ledge. Bed of stone is 8 to 9 feet thick, with a top of 15 feet of rock, in which shaly streaks occur. The stone is of fair quality, fine grained and of good blue color. The bed dips slightly to the south and west. Two men are employed during summer months. Product is mostly edge stone, which is sold to Smith & Yeager at Catskill.

To the south of the above are the quarries near Kiskatom and High Falls, where six openings are being worked, as follows.

Bean & Lewis, Kiskatom. Quarry is situated $\frac{3}{4}$ mile south of Kiskatom. Bed of stone is 5 feet thick with 12 to 15 feet of clay top. Stone is fine grained and full of reeds, and of very dark blue color. No danger of reeds opening when stone is split to

10" thick. Lifts vary from 10" to 24" in thickness. This stone does not work well under planer, being very tough. No "head-offs" are seen in the opening. Product is mostly edge stone, which is hauled 7 miles to Malden and sold to Ulster blue-stone co. Cost of cartage is 26% of value of load. Four to five men are employed during the summer months.

Dederick Bros., Kiskatom. This is a small quarry situated east of Bean & Lewis and on the ledge below their quarry. Bed of stone is $2\frac{1}{2}$ feet thick with 7 to 8 feet of clay top. When this quarry was first opened, the bed was much thicker, but, as the quarrymen say, it has "pitched out." Stone is of medium sized grains and good blue color. Reeds are present but are said not to open from the weather. No head-offs are to be seen. Bed dips to the south and west. The ledge has been opened up 300 to 400 feet in a north and south direction. Lifts vary from 2" to 10". Product is flag and edge stone, which is sold to Smith & Yeager at West Camp. Three men are employed all the year.

Smith & Yeager, Kiskatom. Quarry is just east of Dederick Bros. and on ledge below. Bed of stone averages 10 feet in thickness with a top of 3 feet of rock, and 12 to 15 feet of clay. The stone is rather fine grained and quite dark blue. Reeds are present, and stone is split 10" or 12" to avoid danger of their opening. Lifts are heavy, 5 to 6 feet thick. Water is troublesome here and is handled by a "Bush" pump. The quarry is equipped with two horse power derricks and a steam drill. As no "heads" are present, the drill is used to break off blocks. The holes are drilled very close together in an east and west line. The distance between the edges of adjoining holes is about $1\frac{1}{2}$ ". After a row of holes has been drilled the width of the block, a new bit is set in the drill, which breaks out the connecting stone between two holes, giving a fluted appearance to the edge of each block. This is the only place in the Ulster county district where this system is used. The product is of all classes of stone, which is hauled to West Camp. This firm is a small buyer of stone from this district and has docks at Catskill and West

Camp (Smiths Landing). It employs six to eight men in the quarry the year round.

Dederick & Frieze, Kiskatom. Quarry is $\frac{1}{4}$ mile north of Smith & Yeager and on the same ledge. Bed of stone is 7 feet thick, with 8 to 10 feet of top, 3 feet being rock, the balance clay. Stone is of medium grain and very "reedy." The reeds are very likely to open on exposure. Bed dips to the south and west. Two to three men are employed the year round. Product is mostly edge stone, which is hauled to Malden and sold to the Ulster bluestone co.

Near this quarry are a number of abandoned openings which have not been worked in several years.

James Sterrett, Saxton. Quarry is situated $\frac{1}{2}$ mile west of High Falls. Bed of stone is 13 feet thick, with 35 to 40 feet of alternating beds of rock and shale top. 22 feet above the top of the stone bed a lift of rather coarse grained gray sandstone occurs 2 feet thick, some of which is sold. This stratum occurs 2 miles south of this quarry in the Michigan quarries. Stone is fine grained and a good blue in color. There are no open seams in the bed. The stone is split along the reeds. The quarry is equipped with horse power derrick and siphon. No head-offs appear, but the side seams are very regular. Product is mostly edge stone, which is sold to the Ulster bluestone co. at Malden. Three or four men employed during the summer months.

Harvey Myers, Ashbury, and Owen Devery, Quarryville. Both work small quarries occasionally in the vicinity of High Falls.

Farther south at Quarryville is one of the most productive points of the whole Ulster county district.

Abraham Miller & Co., Quarryville. The first quarry south of Sterrett's. Quarry is situated 1 mile north of Quarryville. The bed of stone is 6 feet thick, with top of 20 to 25 feet consisting of rock and black shale. The stone is fine grained, of good blue color and quite reedy. As the lifts vary from 5" to 6", there is no danger of the stone "reeding" open. Few heads are present. The strata worked dip to the south and west. The

quarry is equipped with hand derrick and siphon. Three men are employed throughout the year. The product is chiefly flagstone, which is sold to the Ulster bluestone co. at Malden.

Con Harvey, Quarryville. This quarry is south of the preceding. The bed of stone is 10 feet thick, with an overburden of 20 to 30 feet, 15 feet of which is rock, the balance clay. The stone is of the best blue color, fine grained and full of reeds, which will not weather open if stone is split to 20" to 24" thickness. No heads are found in this quarry, but the side seams are very regular, 3 to 9 feet apart.

The top part of this bed is grayer and harder than the lower lifts, which are soft and blue. All the stone, however, works well in the mill. The product is almost entirely "rock." Four to five men are employed all the year. The equipment consists of a steam pump to handle the rain water, and that issuing from springs in the quarry. Some very large stones have been taken from the quarry, one slab being 9 inches thick and 17 feet by 16 feet in area.

Alfonso Carnright, Quarryville. This quarry is on the same ledge as Harvey's and just south of it. The bed of stone is the same, but the top is 35 feet thick. The gray sandstone noted under Sterrett's quarry shows here in the top. These two quarries are known as the "Michigan" quarries. The ledge is owned by the Ulster bluestone co. of Malden, which buys all the stone. There is only one lift in the bed, but the reeds are so frequent that the stone is easily split.

These quarries were very valuable at one time and have produced a large amount of stone, but now the top is very heavy for the bed, and only skilful quarrying makes it possible to operate them profitably.

The rock is hauled 4 miles to Malden at a cost of 20% of the value of each load. The prices paid vary from 3c to 5c an inch of thickness per square foot. Carnright employs four or five men throughout the year.

South of and below the Michigan ledge is the Quarryville ledge, which has been opened for over a mile in a north and south direction. This was the great ledge of the district at one

time, 350 to 400 men being employed at different points. The whole ledge is owned by the Ulster bluestone co. at Malden, to which all the stone is sold. The lifts are very thick, and the chief product is rock and edge stone. The dip of the bed is to the south and west. The water from springs and rains is concentrated at the lower end of the opening, where it is handled by steam pumps installed and operated by the Ulster bluestone co. Each quarryman is charged 5% of the value of the stone quarried, in addition to the rental, for the operation of these pumps.

The bed of stone is fine grained and of good blue color, and reedy. The top lifts are grayer and harder than the bottom lifts. The bed averages 13 to 14 feet thick, 8 feet of which are really good workable stone. The top consists of clay rock and shale of varying thickness, the average being 20 feet. The lifts vary from 6 inches to 6 feet in thickness. The top lifts are worked into edge stone, the lower lifts being sold as rock.

Each firm has either a hand or horse power derrick. Some of the derricks are not owned by the firms, who pay a rental for their use of 5% of the value of the stone produced. 18% of the load value is charged for cartage to Malden.

The different firms working the ledge from north to south and the men employed are given. All are of Quarryville.

Rightmeyer, Bovee & Craft. Three men the year round.

K. Foley. Four men 10 months in the year.

John O'Rourke. Four men nine months in the year.

Hollenbeck & Miller. Four men in summer and two men in winter.

Mack & Kraft. Four men in summer and two men in winter.

C. E. Cook. Three to four men nine months in the year.

Cook & Schoonmaker. Four to five men nine months in the year.

Just east of the main Quarryville ledge and below it another ledge has been opened.

Michael O'Rourke, Quarryville. This is the first ledge west of the Hudson river that has been opened. The bed of stone is 7 feet thick, with 2 feet of rock, $7\frac{1}{2}$ feet of shale and 2 to 3 feet of

clay top. Stone is of fairly good blue color, fine grained and reedy. The lifts vary from 2 to 3 feet, and are split to 6" or 7" for safety. Three to four men are employed steadily. The ledge is owned by Joseph Maxwell of Saugerties, to whom the stone is sold. The product is chiefly curb and flagstone. The quarry is equipped with a hand pump for disposing of water.

Just above the west of the main ledge at Quarryville two other ledges have been opened.

Van Steenburg & O'Connor, Quarryville, are working the first ledge above. The bed is 6 to 7 feet thick, with 15 to 20 feet of rock top. The quarry is an old one and is badly blocked up with rubbish. The stone is of fair quality and color. The quarry is equipped with hand derrick. Two men are employed part of the year.

Cunningham & Schoonmaker, Quarryville, are working on the next ledge above. The bed, which is a mixture of rock and stone (the larger portion being rock) is 12 feet thick and has a top of 5 feet of rock and clay. The stone is much darker blue than that from the main ledge, and of finer grain. The lifts vary from 2" to 4". The product, entirely flag, is sold to T. J. Dunn & Co. at Malden. Two men are employed. The quarry is equipped with hand derrick and siphon.

Between Quarryville and Veteran postoffice there are a few small quarries.

Lawrence Hummel, Quarryville. Quarry is situated $\frac{1}{2}$ mile west of Mt Airy. The bed of stone is 4 to 5 feet thick, with 8 to 10 feet of top of rock and clay. The stone is of medium grain and very dark blue color, and quite reedy. The lifts vary from 6" to 8" in thickness. The bed dips more sharply than usual to the west and south. Product is chiefly flag, which is sold to T. J. Dunn & Co. at Malden.

Carty & Rourke, Veteran postoffice. Quarry situated $\frac{3}{4}$ mile north of Veteran or Unionville. The bed of stone is 7 to 8 feet thick, with 8 to 10 feet of clay and rubbish top. The stone is of a good blue and varies in grain from top to bottom. The top lifts are of coarser grain, and harder than the bottom lifts. A

rough streak 1 to 2 feet thick occurs in the center of the bed. The stone is reedy and is split to 10" to 16" for safety. No head-offs are to be seen, but the side seams are straight and regular 3 to 9 feet apart. The product is principally edge stone, which is sold to Hudson river bluestone co. at Saugerties. The quarry is equipped with horse power derrick and siphon. Three to four men are employed all the year.

Brink & Jones, Veteran postoffice. A very small and poor quarry on ledge above Carty & Rourke's. The bed is very rough and 3 to 4 feet thick. The stone is fine grained and good blue in color. Two men are employed, not regularly.

Martin Dunn, Veteran postoffice. This is an old quarry on ledge above Carty & Rourke's and is badly blocked up with rubbish. The bed of stone is very rough and 5 to 6 feet thick, with 7 to 8 feet of rock top. It is fine grained and of good blue color. The lifts are 6" to 8" thick. The product is sold to James Maxwell at Saugerties. Two men employed, intermittently.

From Veteran postoffice south through Fish Creek and Highlands is another very productive territory. But the industry has decreased in late years, specially at Fish Creek, where the surrounding hills are covered with old rubbish heaps. At Veteran postoffice there are numerous openings, but only a few quarries are being worked now.

Wyman Spring & Flynn, Veteran postoffice. Quarry situated $\frac{1}{2}$ mile west of Veteran postoffice. The bed of stone is 4 to 5 feet thick, with top of 10 to 12 feet of rock. The bed dips more sharply than usual to the south and west. The stone is fine grained, of good blue color, and some reeds are present. The side seams and heads are quite regular. Streaks of shale appear in the bed. Three men are employed throughout the year. The product is sold to the Ulster bluestone co. at Malden.

Flanagan & Connors, Veteran postoffice. This firm is working on the same ledge as Wyman & Co., and just east of them. The bed is only $2\frac{1}{2}$ feet thick, with the same amount of top. The dip is in the same direction as that in the preceding quarry, though more gentle. The stone is of a lighter shade of blue. Two men

are employed throughout the year. The product is sold to James Maxwell at Saugerties.

Along the road from Veteran postoffice, running south through Fish Creek and Highwoods are numerous quarries. Just south of Veteran is the following quarry.

William Hayen, Veteran postoffice. The bed of stone is 10 to 12 feet thick, with 10 to 12 feet of top, which is mostly shale. Bed dips as usual to the south and west, and the bedding planes are irregular. The stone is fine grained, of good blue color and reedy. The rifts vary from 20" to 24", which are split into curb. Two men are employed throughout the year. The product is sold to James Maxwell at Saugerties, who owns the ledge.

Eygo Bros. & Cronin, Veteran postoffice. This firm works on same ledge as Hayen. This ledge has been opened about $\frac{1}{4}$ mile in a north and south direction. Three men employed throughout the year.

John Ferguson, Veteran postoffice. This quarry is just east of Hayen's and on the ledge above. It is being worked toward the east and against the dip. This is unusual, nearly all the quarries being worked from the east toward the west. The bed of stone is 5 to 6 feet thick, with 10 feet of shale top. The stone is fine grained, of good blue color and reedy. The lifts vary from 24" to 30". The head-offs are not very prominent and the side seams are somewhat irregular. The product is principally curb, which is sold to James Maxwell at Saugerties, who owns the ledge. Three to four men are employed during the year. This ledge has been extensively worked, but the top is becoming too heavy for the bed.

John Cusick, Veteran postoffice. Quarry is on same ledge as Ferguson, but just north. The top is somewhat thicker, being nearly 60 feet of shale. There is a curious streak in the shale, in which large round boulders are bedded. Two to three men are employed.

Brennan Bros. & Ledwith, Veteran postoffice. This quarry is situated $\frac{3}{4}$ mile south of Veteran and is in the vicinity of

numerous abandoned openings. The bed of stone is 4 to 5 feet thick, with a rock top of 10 to 12 feet. The stone is of medium grain, good color and some reeds are present. The lifts vary from 5" to 8" in thickness. The bed dips more sharply than usual to the southwest. The product is principally curb, which is sold to the Ulster bluestone co. Three men are employed throughout the year.

Daniel J. Burke, Veteran postoffice. Quarry situated south of Brennan's. The bed of stone is 4 feet thick, with 5 to 6 feet of rock top. The stone is of fair blue color, fine grained and somewhat harder than is usual in this vicinity. The quarry is said to work "hard." The side seams are very regular and the joints are loose. Lifts vary from 4" to 20". The product is edge stone, which is sold to the Hudson river bluestone co. at Saugerties. Four to five men are employed throughout the year. The cost of cartage in this vicinity is based on the number of feet of stone in each load.

T. H. Lockwood, Saugerties. The quarry is situated just north of Fish Creek. The bed of stone is 11 feet thick, with a top of 10 to 15 feet. The stone is of good blue color, fine grained and reedy. The lifts vary from 6" to 10", and are split into curb, the principal product. The bed dips south and west. Some blasting is done in the quarry bed, as the heads are absent. The side seams are quite regular and tight. Quarry is equipped with hand derrick. Four to five men are employed during the year. The product is sold to James Maxwell at Saugerties.

Southeast of Fish Creek on Cockburn hill a number of quarries are in operation. One long ledge has been opened on the southern side of the hill, and with two exceptions all the firms are quarrying on this ledge. The ledge has the usual south and west dip, so the drainage is natural toward the lowest and western quarry. The bed of stone averages 7 feet in thickness, is fine grained, of good blue color and quite reedy. Where the ledge has been worked back any great distance, the lifts are heavy, but are easily split along the reeds. Heads are not present as a rule, but the side seams are quite regular.

The ledges are owned by James Maxwell of Saugerties, who buys the output. The top lifts are usually harder than the lower ones.

The following are the operators.

Daniel Darrigan, Saugerties. Bed of stone is 4 to 5 feet thick, with 12 to 15 feet of rock top. Bed dips to the south and west gently. Stone is of medium grain, good blue color, but very reedy. The lifts vary from 4" to 8" in thickness. Both systems of vertical joints are present. The product includes all varieties of marketable stone. Five to six men are employed.

Lahert Bros., Highwoods. Bed of stone 6 feet thick, with 9 feet of top, 1 foot of which is rock, the balance being clay containing boulders. Stone is light blue, fine grained and reedy. Lifts are quite heavy, being as thick as 4 feet. Bed dips gently to the southwest. The product is mainly curb. Four men are employed during the year.

Daniel Darrigan, Veteran. Quarry on the same ledge as that of Lahert Bros. One man employed during the year.

Mrs John Darrigan, Highwoods. The bed of stone here is 8 feet thick, with 20 feet of clay and rock top. The stone is a darker shade of blue than that in Laherts' opening. A shale streak also appears in the bed here. The product includes all varieties. Four to five men are employed during the year. The quarry is equipped with a hand derrick.

Richard Lannigan, Highwoods. The bed is the same in thickness and quality of stone as at Darrigan's, but the top is somewhat different, consisting of 3 to 4 feet of clay, 4 feet of shale and 3 feet of rock. The top lifts of this bed are hard, while the lower lifts are softer. No heads are present. The product is chiefly edge stone. Four men are employed throughout the year. A hand derrick is in use.

William Scott, Highwoods. The bed here is not quite so thick, about 7 feet, with 10 or 12 feet of top, mostly shale. The quality of stone is the same. Four men are employed during the year.

James Darrigan, Veteran postoffice. Three men are employed at this quarry, which is close to Scott's, and resembles that quarry in the quality of bed and thickness.

Whittaker & Manerstuck, Veteran postoffice. This is on the same ledge as the preceding, but on the northern side of the hill. The bed is 7 to 8 feet thick, with only a clay top of 3 feet. The quality of stone is the same as in the other quarries. On account of the dip and the direction of working, water is somewhat troublesome. The lifts are 8" to 10" thick.

On ledges above the main ledge are numerous abandoned workings, a few of which are being reopened.

John Skchill, Veteran postoffice. The bed of stone is 4 to 5 feet thick, with 10 feet of rock and clay top. A shaly streak is present in the bed. Only one man is employed, eight months in the year.

Lasher Bros., Veteran postoffice. This quarry is on a ledge higher than Skchill's and was abandoned at one time. The bed is 4 feet thick, with 20 feet of rock top. The stone is of good blue color, fine grained and reedy. Heads and side seams are present, and the dip is to the south and west. Two men are employed.

South of Cockburn hill is the Highwoods district. Three different ledges are being worked. On the lowest and most eastern seven firms are quarrying. All the ledges are being worked to the west with the dip. On account of this, water is troublesome in places. The bed of stone averages 12 feet in thickness. The bedding is rather uneven in spots, which causes a great deal of waste. The stone is fine grained, of good blue color and reedy throughout the ledge. The ledge has been worked for a number of years, and the lifts are heavy as a rule. The side seams are quite regular and smooth, but the heads are few and far apart. The top is chiefly shale or pencil. Some shaly streaks appear in the bed. The dip is to the south and west. Blasting is sometimes necessary in getting out the stone.

The following are the operators.

Vedder & Hackett, Highwoods. The bed here is rough and several pencil or shale streaks appear. Four men are employed. The equipment consists of a steam boiler, pulsometer pump and horse power derrick. The product is sold to the Ulster blue-stone co. at Glasco.

Richard Rind, Highwoods. Works intermittently, just south of Vedder & Hackett.

Kelly & Hackett, Highwoods. The bed here is 12 feet thick, with 10 feet of shale and clay top. The top 3 feet of bed are hard, while the bottom 9 feet are softer, but do not split so well. The product is mainly curb, which is sold to James Maxwell at Glasco. Four men are employed. The equipment consists of steam boiler, centrifugal pump and steam drill, which has not been used in the quarry as yet.

Thomas Rafferty, Highwoods. The bed is rather rough here. Two men are employed during the year. Edge stone forms the product, which is sold to James Maxwell at Glasco.

Riley Bros., Cockburn. Only 4 feet of the bed are being worked here, owing to rough streaks in lower lifts. The shale top is 15 feet thick. The product is chiefly curb, which is hauled to Glasco and sold to James Maxwell.

William Lannigan, Highwoods. The bed is 14 feet thick, with 12 to 25 feet of shale top. The lifts vary from 14 inches to 4 feet. The product is sold to T. J. Dunn & Co. at Malden. Eight to nine men are employed throughout the year. The quarry is equipped with horse power derrick and pump.

Daniel Rafferty, Cockburn. Works on this same ledge intermittently.

Two quarries are worked on the ledge to the west and the above described ledge. The bed is 11 feet thick, with the shale top 15 to 20 feet thick. Rough streaks occur in the bed occasionally. The stone is fine grained, reedy and of a good blue color, and is easily worked. The lifts vary from 6 inches to 3 feet. The side seams are smooth and regular, 3 to 10 feet apart. Water is troublesome in a wet season. The product from the two quarries is chiefly curbstone and is sold to Thomas J. Dunn & Co. at Malden. The following are the operators.

Lawrence Kenney, Kingston. Employs eight to nine men throughout the year. The equipment of the quarry consists of horse power derrick and pump.

Levi Carle, Cockburn. Two men are employed during the year. A hand derrick is the equipment.

The next ledge to the west is known as "High bank." Only four quarries are in active operation, though this ledge and the one below it have been extensively opened for some distance. The bed of stone averages 6 feet thick, with various thicknesses and kinds of top. The stone is fine grained, of dark blue color, and with numerous reeds. Side seams and heads are both present at varying distances apart. The dip of the bed is the same as that of the other ledges south and west. The bed has rough streaks through it and cross bedding is seen. Stone and rock are interbedded in spots. The lifts vary from 6 inches to 3 feet. The top and bottom lifts are hard, while the middle of the bed is softer. The product includes all the varieties of marketable stone and is sold to James Maxwell at Glasco.

The following are the operators.

Conlon Bros., Cockburn. Six to eight men are employed throughout the year. A siphon handles all the water.

Hackett & McCormick, Highwoods. Four to five men are employed throughout the year.

Hackett Bros., Cockburn. Three men are employed throughout the year.

Jake Connor, Highwoods. One man works intermittently at this southern end of the opening.

Three quarters of a mile west of the "High bank" ledge a number of quarries have been opened. It is not possible to say whether these quarries are on the same ledge, as there is no continuous opening.

Carle & York, Highwoods. This quarry is situated $1\frac{1}{2}$ miles southwest of Highwoods and more men are employed than in any other quarry in Ulster county. The quarry has not been opened on the outcrop of the ledge, which is the usual rule. The opening is in the shape of a rectangular pit in the middle of a level field. The ledge is worked on three sides of the pit, the perimeter of the face being 425 feet. The dip of the bed is gentle and to the west mainly. The water collects in the western end, and is pumped out by a rotary pump driven by steam. The top is hardpan 3 to 4 feet thick and is troublesome to strip. It is blown off as much as possible with powder, the balance being

handled by shovels and barrows. The bed varies in thickness, varying from 3 to 8 feet, averaging 6 feet. Stone and rock are interbedded throughout the whole bed. The stone is fine grained and of good blue. The top lifts are harder than the lower ones. It is excellent stone for mill work. Side seams are regular and smooth and are from 1 foot to 8 feet apart. No heads are present. The product is sold to the Ulster bluestone co. at Glasco and to the Hudson river bluestone co. at Saugerties. Fifteen men are employed 10 months in the year. \$8000 is the value of the product for the season. Quarry is equipped with horse power derrick.

James Van Aken, Highwoods. Quarry is north of Carle & York's. The bed of stone averages 12 feet in thickness, with 7 feet of clay and 5 feet of shale top. The stone is fine grained, of good blue color, reedy and compact. The lifts vary from 6" to 14". The reeds in the stone are said to be very tight. Water is troublesome and is handled by a steam-driven rotary pump. Powder is used in quarrying the stone, as well as the top, owing to the absence of heads. The side seams are regular and smooth and 10 to 25 feet apart. Five men are employed during the year. The product of various kinds is sent to James Maxwell at Glasco and Saugerties.

Nelson Felton, Highwoods. This quarry is $\frac{1}{2}$ mile north of Van Aken's. The bed of stone averages 7 feet, with 8 to 10 feet of shale top. A number of slaty seams appear in the bed, which is rather rough. The stone is fine grained, of good blue color and reedy. The lifts vary from 4" to 12". The bed pitches to the south and west gently. The side seams vary from 1 foot to 4 feet apart. No heads are present. The product of edge stone is sold to Hudson river bluestone co. at Saugerties. The equipment of the quarry includes steam-driven rotary pump and horse power derrick. Seven to eight men are employed throughout the year.

Van Bramer Bros., Highwoods. This quarry is northwest of Felton's. Bed is 8 to 9 feet thick, 6 feet of which are workable stone, the balance being rubbish interbedded with the stone.

There is not much variation in the quality of the bed. The top is of hardpan 5 feet thick. The stone is a good blue in color, fine grained and reedy. The lifts vary from 8 inches to 3 feet. The product consists chiefly of edge stone, which is sold to James Maxwell at Glasco. Four men are employed during the year. A hand derrick is the only equipment.

William Doyle, Highwoods. One man works on same ledge as Van Bramer intermittently.

Benjamin Meyers, Highwoods. Quarry situated north of Van Bramer. Bed is 5 to 6 feet thick with 7 to 10 feet of rock top. The stone is fine grained, reedy and dark blue. The bed has the usual dip to the southwest. The lifts vary from 2" to 12". No heads are present. The product includes all varieties and is sold to James Maxwell at Glasco. Three to four men are employed during the year. The equipment consists of a siphon and hand derrick.

Carle Bros., Cockburn. Bed of stone varies from 2 to 3½ feet in thickness. The top consists of rock and clay 5 feet thick. The stone is fine grained, reedy and of good blue color. The lifts vary from 2" to 6". No heads are present and the side seams are variable. The bed dips to the south and west. The product of flag and curb is sold to the Ulster bluestone co. at Glasco. Three to four men are employed.

Wesley Greene, Highwoods. This quarry was stripped of the upper bed and abandoned for 25 years. A lower bed of 2 feet is now being quarried. The top consists chiefly of rubbish from the old bed 3 to 8 feet thick. The stone is fine grained, of good blue color. The product is curb and flag, which is sold to James Maxwell at Glasco and to Ulster bluestone co. at Saugerties. Two to three men are employed nine months in the year. A hand derrick is in use.

James Depuy, Highwoods. Quarry situated 1 mile southwest of Fish Creek. The bed of stone is 4 feet thick, with rough streaks through it, and is about exhausted. Top consists of shale 2 feet thick. The stone is fine grained, of good blue color, and reedy. The lifts vary from 5" to 6". Curb and flag are the

principal products, which are sold to Ulster bluestone co. at Saugerties. Three men are employed during the year.

Charles Green, Highwoods. Quarry situated near Highwoods postoffice. The bed of stone is 6 to 8 feet thick and is badly shattered in places. The top varies from 2 to 15 feet of rock and streaks of shale. The bed dips to the southwest. The stone is fine grained, of good blue color, and somewhat reedy. The quarry is being worked toward the east. The lifts vary from 3" to 12". The side seams are 2 to 12 feet apart. Product is sold to Ulster bluestone co. at Malden. The equipment consists of horse power derrick and siphon. Four men are employed during the year.

South of the Highwoods district are the quarries near Dutch Settlement. Here, as at other points, the industry has declined of late years. The description of the quarries follows.

John Vederkill, Ruby. Bed of stone 4 feet thick with 6 feet of stripping, of which 5 feet are clay, balance rock. The stone is of fair quality as to color and grain. The lifts are quite heavy. The bed here dips to the north and west. Product is chiefly curb and other edge stone. The product is sold to Ulster bluestone co. Four to five men are employed nine months in the year.

Henry Hart, Ruby. The bed of stone is 2 feet thick with 1 foot of soil top and 2 of rock. The stone is of fair quality regarding color and grain. The lifts are light, flag being the main product. The joints are irregular and tight. Only one man is employed. The stone is sold to James Maxwell at Glasco.

J. A. Longendyke, Ruby. This quarry is near Hart's and on the same ledge. The lifts are somewhat heavier, the product being edge stone. Three men are employed during the year. The product is sold to James Maxwell at Glasco. The quarry is equipped with siphon to drain the water.

Conrad Young, Ruby. The bed of stone is 4 feet with a top rock of 2 feet. The stone is rather fine grained and good blue in color. The bed dips south and west. Some reeds are found in the stone. The product is of all varieties and is sold at

Glasco to James Maxwell. Three men are employed throughout the year.

Charles Steifle, Ruby. Bed of stone is 5 feet thick with 6 feet of rock top. The stone is of good quality. The quarry is the best in the district. The lifts vary from 2" to 6". The bed dips to the south and west. Product includes all varieties, and is sold to James Maxwell at Glasco. Four men are employed during the year.

J. Gaddis & Son, Ruby. This quarry is on ledge above Steifle's and is very small. The bed is 3 feet thick, with 5 feet of rock top. The product is sold to James Maxwell at Glasco. Two men are employed.

Jake Stice, Ruby. The bed of stone is 5 feet thick with 10 feet of rock top. The product of flag is of good quality. Lifts are light and easily raised from the bed. The bed of stone rests on pencil. The face of the quarry extends north and south 75 feet. The bed dips to the south and west at a gentle angle. Product is bought by Ulster bluestone co. at Glasco. Three men are employed eight months in the year.

Van Hoevenburg & Nuger, Ruby. The bed of stone is 10 feet thick with 15 feet of rock top. The dip of the bed is to the south and west. The quality of the stone is very fair. All varieties are produced and sold to James Maxwell at Glasco. Three men are employed during the year.

McDonald & Lahey, Ruby. The bed of stone is 4 feet thick with 12 feet of rock top stripping above. The stone is fine grained, of good blue color and somewhat reedy. The bed pitches to the north and west gently. The product including all varieties is sold to James Maxwell at Glasco. Two men are employed.

Hart & Burns, Ruby. The quarry is on the same ledge as McDonald & Lahey's. The bed varies from 5 feet to 7 feet in thickness here, with 5 feet of rock stripping. The water from both quarries collects here and is drained by a pipe. The quality of the stone is the same. The product, chiefly flag, is sold to James Maxwell at Glasco. Three men are employed.

Scheffel & Krell, Ruby. The bed of stone is 8 feet thick, with 15 feet of rock stripping. The stone is of good color and quality. The lifts are quite heavy, producing chiefly edge stone. Water is troublesome and a siphon is in use. The product is sold to James Maxwell at Glasco. Two to four men are employed.

Constance Halbleib, Ruby. The bed of stone is 8 feet thick, with a rock top of 30 feet. The ledge has been worked for 400 yards and was very productive at one time. The stone is of good quality as to color and grain. The lifts are heavy but reedy. The product consists of edge stone, which is sold to Ulster bluestone co. at Glasco. Three men are employed six months in the year.

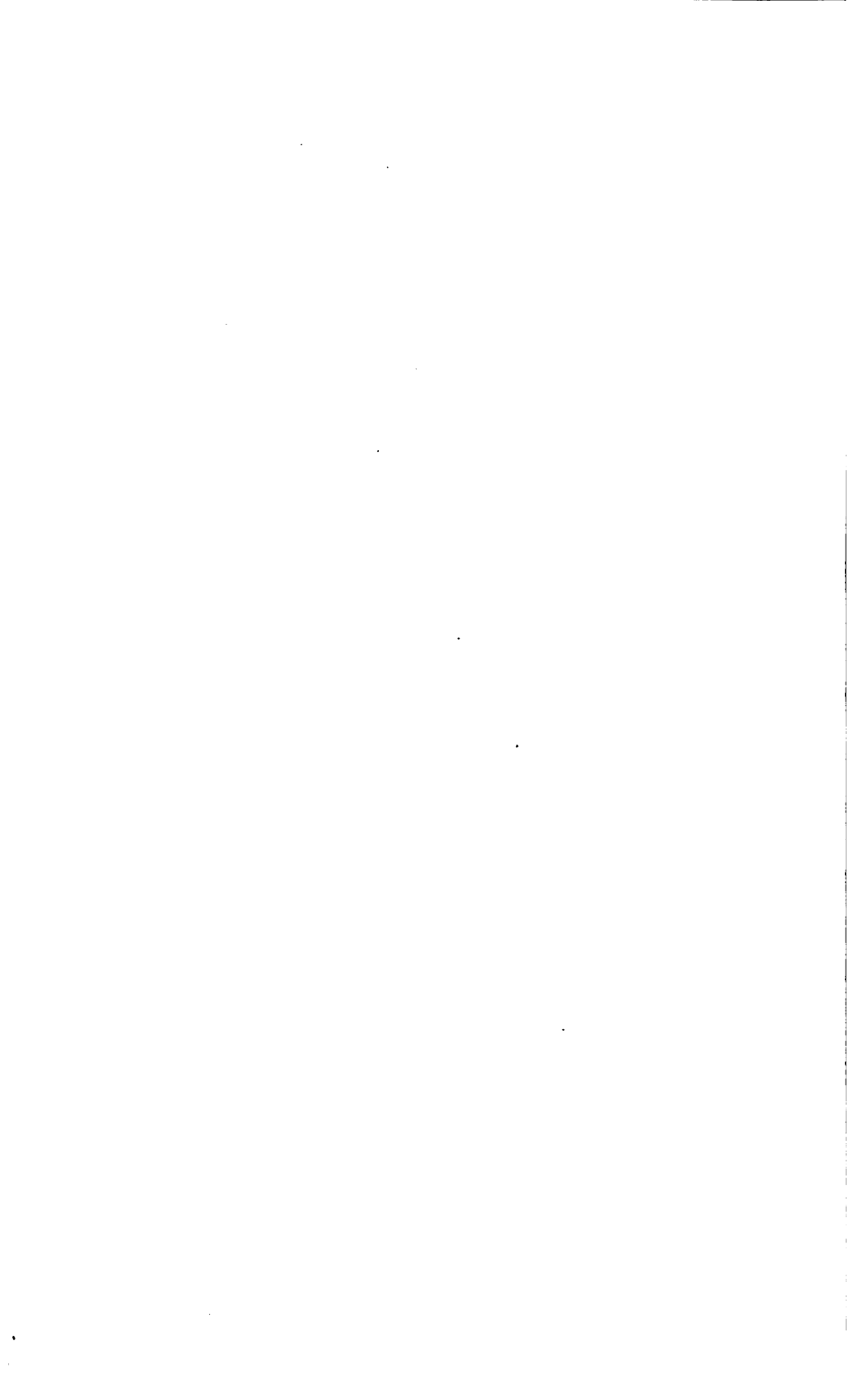
Sheehan Bros., Ruby. The bed of stone is 8 feet thick, with 25 feet of rock top. The stone is of medium fine grain, good color and reedy. The lifts are quite heavy, ledge stone being produced principally. The product is sold to Ulster bluestone co. at Glasco. Two men are employed throughout the year.

Lannigan Bros., Cockburn postoffice. The bed of stone is 5 feet thick with 10 feet of rock stripping. The stone is fine grained, reedy, and of good blue color. The lifts vary in thickness from 2" to 6". All varieties of salable stone are produced, and sold to James Maxwell at Glasco. The quarry is equipped with derrick and horse power pump. Four men are employed during the year.

South from Dutch Settlement are the quarries on Hallihan hill. These are nearly exhausted now, though some are worked intermittently. The only permanent operator is

Chris. McGuire, Katrine. The bed of stone is $4\frac{1}{2}$ feet thick, with 14 to 15 feet of rock top. The stone is of good quality and works fairly well. The product of all varieties is sold to James Maxwell at Glasco. Two to three men are employed intermittently.

Along Sawkill creek a number of quarries have been opened, but only four are in active operation.





H. T. Dickinson, photo.

View of waste weir of Kingston reservoir no. 1, in Sawkill valley, Ulster co. N. Y. looking west, showing ledges of bluestone

T. McDonald, Sawkill. Quarry is situated 250 feet above the bed of Sawkill creek on the north side. The bed of stone is 6 feet thick, with 10 feet of rock top. The stone is of excellent quality as to color and grain. Some powder is used in blasting out the bed, owing to the tight joints. The product, edge stone and rock, is sold to Hewitt Boice at Kingston, who owns the ledge. Six to seven men are employed.

John McCaffery & Co., Sawkill. This quarry is situated in the bed of the creek on the north side. A flume has been put in for keeping the creek waters out of the quarry, which is being worked below the level of the creek. The bed of stone is 10 feet thick, with 12 feet of rock stripping. The bed is somewhat thicker than 10 feet, but is not worked. The stone is of medium grain, of good blue color and reedy. The vertical jointing is all north and south. All varieties of commercial stone are produced, and sold to Hewitt Boice at Kingston. A horse power derrick is in use. Four to five men are employed throughout the year.

W. McCaffery, Sawkill. The quarry is on ledge overlying McCaffery & Co.'s quarry. The bed of stone is 4 feet thick, with rock top of 6 feet. The stone is of the same quality as usual along the Sawkill. Julius Osterhoudt owns the ledge and buys all the stone quarried. One man and one boy employed during the year.

South of the Sawkill is the Jockey hill district. One ledge has been opened for nearly a mile in length, and a number of firms are quarrying stone from it. Two more ledges above the main one have been opened and are being worked on a small scale. This hill was once very productive, but, as in other places in Ulster county, the industry has declined. Old rubbish heaps are to be seen on every part of the hill.

The main ledge averages 8 feet of stone, which is medium grained, grayish blue and somewhat reedy. The stripping is of rock 5 to 6 feet and clay 4 to 12 feet. The ledge is owned by Julius Osterhoudt and Hewitt Boice, to whom the stone is

sold at Wilbur and Kingston. The price of cartage here is based on the number of feet of stone per load. 1c an inch of thickness per square foot of surface is paid for hauling "rock" to market. 6c a linear foot is paid for curbing.

The dip of the ledge is to the north and west. The opening extends north and south, so that the quarries at the northern end receive the water from the other quarries. Owing to different depths of the different workings, water is troublesome in nearly all the quarries. The water is drained by siphons of 2" cast iron pipes, equipped with a small hand pump at the apex; 10 to 15 feet is the usual fall allowed. These siphons, when the pipe is well jointed, are very efficient, removing a large amount of water in a short time.

The thickness of the lifts varies from the top to the bottom, the top lifts are light, 2" to 3", while the lower ones are heavier, 6" to 10". Obviously, the top lifts produce flag, and the lower lifts edge stone and rock. Many of the quarries are equipped with a hand derrick for handling the heavy stones. A rough streak appears in some parts of the ledge 2 feet thick and causes some waste. The vertical jointing is north and south, and east and west. Owing to the tightness of these joints, powder is often necessary in the lower lifts.

The following are the operators.

James Howard, Sawkill. Two men employed during the year.

John Murphy, Sawkill. Three men are employed during the year. A siphon is used for drainage.

Thomas Hayes, Sawkill. Five men are employed throughout the year.

Burns Bros., Sawkill. Four men are employed. A hand derrick is in use.

T. McDonald, Sawkill. Ten men are employed throughout the year. The equipment consists of siphon and hand derrick.

B. C. Callahan, Sawkill. Three men are employed.

W. Sheely, Kingston. This quarry used to employ 10 men, but only two are at work now. Water is very troublesome and two siphons are in operation. A hand derrick is also part of the equipment.



H. T. Dickinson, photo.

**Bluestone quarry of T. McDonald in bed of Sawkill creek showing sluiceway for water in creek,
looking northwest**



H. T. Dickinson, photo.
 Bluestone quarry of Tom Gad on Jockey hill, Ulster co. N. Y. looking northeast, showing bed of stone
 and pencil (slate) stripping

William Charlton, Sawkill. Two men employed the year round. Quarry equipped with siphon.

W. F. Watson, Sawkill. Two men employed. A siphon is in use.

Sheehan Bros., Sawkill. This quarry is on ledge above the main Jockey hill ledge and is only opened here. The bed of stone is of rather poor quality and only 4 feet thick. The stripping amounts to from 15 to 18 feet of clay and rock. The ledge is owned by Hewitt Boice, who buys the output at Kingston. Two men are employed.

Tom Gad, West Hurley. Quarry is situated on Morey hill just west of Jockey hill. The bed of stone is 10 feet thick with 20 feet of shale stripping. The face of opened ledge is 250 feet long in a north and south direction. The stone is medium grained and of good blue color. Reeds are present. The side seams are regular and smooth. The product is almost entirely edge stone, which is sold to different buyers in Kingston. Eight men are employed in the quarry.

Mrs J. McRieff, West Hurley. Quarry on same ledge as Gad's, but located on opposite side of the hill. The quality and thickness of bed is the same, but the stripping is 30 feet of shale. The product is sold to Hewitt Boice at Kingston. Two men are employed.

Following this line of quarries south from Jockey Hill, it turns westward in a direction parallel to the Rondout creek through the following quarry districts: Stony Hollow and West Hurley, Morgan hill, Lapala, Atwood, Vly, Scarawan and Mackey hill. The quarries will be described in order.

At Stony Hollow and West Hurley the same conditions hold as in many others of the districts in Ulster county, viz, the beds have been worked out as the stripping has become too heavy for profitable operation.

Owen Grant, West Hurley. Quarry is at Stony Hollow. Bed of stone is 10 feet thick, with an equal amount of stripping of rock. The stone is of excellent quality for curb and cross walks. It is not suitable for building purposes, as small round spots in

the stone stain badly when exposed to the weather. The lifts vary from 4" to 8" in thickness. Side seams and heads are both present. The quarry is equipped with horse power pump and two dump carts. The product is hauled to Wilbur and sold to various dealers at Wilbur. Twelve men are employed.

Doyle & Co., West Hurley. The bed of stone is 10 feet thick with 15 to 18 feet of stripping. The stone is fine grained, blue-colored and reedy. The ledge has been opened 100 feet in a north and south direction. The vertical joints are well developed. The product is sold to various dealers at Wilbur. Six men are employed.

T. J. Conroy, West Hurley. The bed of stone is 10 feet thick, with 25 to 28 feet of rock and shale top; the lifts vary from 4" to 8"; and the stone is very dark blue and fine grained. The systems of vertical joints are well developed. The length of face is 75 feet. The product is sold to the Hudson river bluestone co. at Wilbur. Three men are employed.

James Devine, West Hurley. Bed of stone 12 feet thick, with 20 feet of rock top. The stone is dark blue and fine grained. Reeds are present. The lifts vary from 4" to 10" in thickness. The vertical joints are quite tight, and powder is used in blasting out the heavier lifts. The product is sold to the Hudson river bluestone co. at Wilbur. Four men are employed.

John Purcell, West Hurley. Bed of stone is 10 feet thick, with a 10 foot thickness of rock overburden. The stone is dark blue and rather fine grained. The lifts are heavy and are split along the reeds. The vertical joints are tight and powder is used in getting out bottom lifts. The product, chiefly edge stone, is sold to the Hudson river bluestone co. at Wilbur. Three men are employed the year round.

McConnell & Charleton Co., West Hurley. This is a very small quarry with 4 feet of bed and 5 feet of rock top. Face is 50 feet long in a north and south direction. The stone is of the average quality of this district. The product is sold to the Hudson river bluestone co. at Wilbur. Two men only are employed.



H. T. Dickinson, photo.

Bluestone quarry of Owen Grant near Stony Hollow, Ulster co. looking north



Lamb Bros., West Hurley. This is another small quarry with only 3 feet of bed, with 7 feet of stripping. The stone is not as good a blue as is usual in the district, and only small sizes of stone are produced. The quarry is equipped with a siphon. The product is sold to Hewitt Boice, Kingston. Two men are employed.

James O'Neill, West Hurley. The quarry is situated $\frac{1}{2}$ mile southwest of West Hurley. The bed of stone is 8 feet thick, with an average thickness of stripping of 10 feet. The lifts vary from 4" to 20". The stone is fine grained and of good blue color. The two systems of vertical jointing are present. The bed dips to the south and west. Some blasting is necessary in quarrying some of the heavier lifts. The Knox system is used. The water is drained by a ditch and horse power pump. The length of face in a north and south direction is 350 feet. The output includes all varieties of marketable stone, and is hauled by wagon to Hewitt Boice at Kingston. O'Neill does his own hauling, and at 70c a ton a profit is made. Ten men are employed 10 months in the year. \$6000 is the value of the product per year.

Martin Lane, West Hurley. This is an old abandoned quarry opened up this year. The face is 75 feet long, in a north and south direction. The bed of stone is 7 feet thick with 10 feet of shale and rock top. The stone is of fair quality and quite reedy. The lifts vary from 4" to 20" and can be split to almost any thickness. The bed dips to the south and west. The output is sold to various dealers at Wilbur, where it is hauled by wagon. A siphon is in use. Three men are employed.

South of West Hurley and Stony Hollow is the Morgan hill and Hurley woods district. The quarries are nearly all abandoned now, only a few men quarrying regularly. Quarrying and farming are carried on together.

Dunn Bros., Hurley. The bed of stone is 4 to 5 feet thick, with 15 to 18 feet of rock stripping. The stone is of medium grain, of good blue color, and reedy. The lifts vary from 4" to 8".

The side seams and heads are well developed. The dip of the bed is to the southwest. The quarry is worked on a very small scale with two men. The product is hauled to Wilbur and Kingston.

Toole Bros., West Hurley. The bed is $4\frac{1}{2}$ feet thick and rather rough. The stripping of rock averages 12 feet. The stone is of medium grain and good blue color. The lifts vary from 4" to 12" and are split into various thicknesses along the reeds. This quarry has been extensively worked, but, as the quarrymen say, "the rock has dipped down into the stone." The product of chiefly edge stone is sold to Hudson river bluestone co. at Wilbur. Three men are employed.

The other quarrymen working at various localities in this district are:

Thomas F. Scully, Hurley.

Fred Krantz, Hurley.

Frank McMullen, West Hurley.

In the Lapala and Roseville districts the following quarrymen are working.

Winchell Bros., Lomontville. The bed of stone is 4 feet thick, with 8 to 10 feet of stripping of rock and clay. The stone is of medium fine grain and fair blue color. The lifts vary from 4" to 5" and are worked mostly into edge stone. The vertical joint systems are as usual. The dip of the bed is to the north and west. Product is sold to Hewitt Boice at Kingston. A siphon is in use. Three men are employed during the year.

A. De Graff, Hurley. The bed of stone varies from 2 to 6 feet in thickness, with 14 to 18 feet of shale and rock stripping. The stone is of good color and grain, but some rough streaks in the bed make a great deal of waste. The dip of the bed is to the northwest. The quarry is equipped with hand pump. Stone is sold to different dealers on the Hudson. Product, flag and edge stone. Two men are employed.

Clearwater, Conner & Hotaling, Hurley. This quarry is on same ledge as De Graff's, and the thickness of bed and stone is the

same. Different dealers buy the stone. Three men are employed.

Thomas Sampson, Hurley. The bed of stone is only 2 feet thick, but has a light top of 4 feet. The quarry is in the bed of Stony creek. The lifts are 4" to 6" thick, producing chiefly edge stone. The grain is fine and the color good. The stone is sold to Julius Osterhoudt at Wilbur. Four men are employed through the year.

W. H. Miller, Lomontville. This quarry is situated on what is known as the Irving ledge, which has been opened for 800 yards in a north and south direction. The bed ranges in thickness from 2 to 6 feet with a top of varying height. The stone is fine grained, of good blue color, and reedy. The ledge is known for the great amount of large "rock" produced. This is the main product today. The vertical joints are very much stained with iron. The stone is sold to Hewitt Boice and the Hudson river bluestone co. Miller employs three men. Water drained by a siphon.

The following also quarry on this ledge:

Ennis & Jones, Lomontville. Two men employed.

John Clearwater, Hurley. Two men employed.

J. Scriver, Hurley. Three men employed.

William Gooches, Lomontville. Two men employed.

William B. Brodhead, Hurley. The bed of stone averages 6 feet, with stripping of clay, shale and rock of 14 feet. The stone is of the average quality of the district. The lifts vary from 2" to 8", and all varieties of stone are produced. A hand pump is used for draining the water. The output is sold to Hewitt Boice at Kingston. Three men are employed.

John J. Sampson, Hurley. The bed of stone is 4 to 5 feet thick, with a rock streak 2 feet thick dividing the bed. The stripping amounts to 9 feet of rock and clay; the latter is 1 foot thick. The product is of all varieties and is of the usual grade of this district. Hewitt Boice at Kingston is the buyer. Three men are employed.

Winchell Bros., Hurley. The bed of stone is 8 feet thick, with a top of shale 25 to 30 feet thick. The stone is fine grained, of good blue color, and reedy. The bed dips to the southwest gently. The ledge has been opened up 200 feet along the side seams. The lifts are heavy, 6" to 9", and the product is principally rock. Hewitt Boice owns the ledge and buys all the product. Four men are employed.

Cornelius Goebel, Lomontville. The bed of stone is 6 feet thick, with 12 to 14 feet of rock top. Some stone is taken out of the top rock, but very little. The bed dips north and west. The stone is of the average quality. All varieties of salable stone are quarried, and sold to Hewitt Boice at Kingston. A siphon is in use. Three men are employed during the season.

Robert Elliott, Hurley. The bed of stone is 12 feet thick, with 14 feet of rock stripping. The stone is fine grained, reedy, and of good blue color. The vertical joints are regular and stained badly with iron. The dip of the bed is to the north and west. The lifts vary from 3" to 10", giving a variety of products. The quarry is equipped with horse power pump and derrick. Hewitt Boice of Kingston buys the product. Four to five men are employed throughout the year.

The quarries south of the Lapala district are all small in size and number. The region through Atwood and Vly was quite productive at one time. South of Vly the Scarawan quarries are being worked on a small scale. The end of this productive line is at Mackey hill west of Kripple Bush, where a long ledge has been opened.

The following are at work in the vicinity of Vly and Atwood.

Green L. Davis, Atwood. A very small quarry between Atwood and Vly. The bed of stone is 4 feet thick, with 10 feet of rock and dirt top. The lifts vary from 4" to 8". The stone is of average quality and is sold at Wilbur to different buyers. One man employed.

Lockwood & Krom, Atwood. This ledge has been opened up for some distance. The bed is 4 feet in thickness, with 6 feet of rock and 1 foot of clay top. The stone is rather coarse

grained and of good blue color. The lifts vary from 2" to 6" in thickness. The dip of the bed is to the north and west. The bed is said to work "hard," and the bedding planes are not smooth. The north and south joining is prominent, and the sides are stained with iron. The stone is hauled 12 miles to Kingston and 14 miles to Wilbur. Two men are employed. Besides the above firm the following are quarrying on the same ledge.

George Winchell, Atwood.

Bush & De Boice, Atwood. Three men are employed eight months in the year.

Charles Ennis, Atwood. One man employed.

The quarries in the Scarawan district are as follows.

Turner Bros., Stone Ridge. The ledge of stone is 12 feet thick, in which 3 feet is the thickness of the workable stone. No sharp line of demarcation between the rock and stone is to be seen. The rock and stone are interbedded. The stone is coarse grained, of good blue color and with few reeds. The top lifts are light, producing flag, while the lower lifts are heavier, 5" to 8". The north and south joints are prominent. The bed dips to the north and west. Two men are employed.

The following are also quarrying on this ledge.

Snow & Smith, Kripple Bush. Two men are employed eight months.

Wagner & Krum, Kripple Bush. This quarry is on ledge just above Turner Bros. and is of the same character. The bed of stone is 3 feet thick, interbedded with 9 feet of rock. Two men are employed.

The following operate on the same ledge occasionally.

J. H. Beatty, Vly. All the Scarawan quarries haul their stone to High Falls on the canal, where it is loaded on barges for shipment. Julius Osterhoudt is the buyer at High Falls.

Jason Beatty, Kripple Bush. This quarry is situated $\frac{1}{2}$ mile east of the Scarawan quarries, but the stone is of the same quality and character. The bed is 3 feet thick, with 4 feet of rock top. The stone is hauled to High Falls to Julius Osterhoudt. One man is employed.

The opening on Mackey hill is 1 mile long and extends part way around the hill. The bed of stone is 10 to 12 feet thick, with a top ranging from 12 to 35 feet in thickness. The top is entirely shale, which when stripped has not been disposed of well, as the quarries are badly blocked in places with rubbish. The stone is rather fine grained, of good blue color and reedy. The lifts are very heavy, 10" to 24". The top lifts do not split well, but the lower ones do. The ledge dips to the south and west, and the water, following the dip, collects at the southern end, where it is removed by siphons. A number of firms are quarrying on the ledge, and many have hand derricks in use. The side seams and head-offs are all tight, sometimes requiring blasting in lower lifts. The product is edge stone and "rock," which is hauled to High Falls on the canal.

The following are quarrymen, all of Kripple Bush.

Osterhoudt & Barley. Two men employed eight months in the year.

Beatty & Vandermark. Two men employed the year round.

W. D. Roosa. Four men employed during the year. The product sold by the quarryman at Port Jackson to various markets. Quarry equipped with hand power derrick.

Davis Bros. Two men employed the year round.

Jacob McMullin. Two men employed the year round.

Rose Bros. Two men employed the year round. Quarry equipped with horse power derrick and pump.

Greene Bros. Two men work intermittently. Quarry equipped with hand derrick and siphon.

O. E. Christian. Two men employed intermittently.

Hector Connor. One man and two boys employed the year round.

To the west of the northern part of this main range of quarries, viz west of the Quarryville, Fish Creek and Highwoods districts, the ledges of stone are terraced one above another, forming as it were the foothills of the Catskill mountains. A number of quarries have been opened in these ledges, but only a few are worked at present. The stone is of poor quality, not evenly

bedded and very apt to "slack" or disintegrate on exposure. Near Fawns a ledge $1\frac{1}{2}$ miles long has been opened, but is now abandoned.

On the eastern face of the mountains, from the Mountain house to Woodstock, and in the Kaaterskill and Plaaterskill cloves quarries are being worked. This stone is known as the mountain stone and differs from the stone quarried lower down in the vertical scale, in color, texture and appearance. The color is very variable, the grain is almost invariably coarse, and few reeds are present. There is less danger from "slacking" or disintegration on exposure, and it is a stronger stone than the fine grained, reedy stone of Quarryville and other similar districts. There is a distinct preference, however, for the typical bluestone; so the mountain stone does not stand high with the buyers.

Quarries have been opened on at least eight different levels on the eastern side of the mountain. On the southern side only one quarry is in active operation. The beds of stone vary in thickness from 4 feet to 12 feet. The amount of top, or overburden, depends on the length of time the quarry has been worked. As the beds are worked out into the mountain, the top increases. When the quarries are first opened, the stone is lighter and sold for flag. As the bed is worked deeper into the side of the mountain, the stone becomes heavier, and rock and edge stone are the chief products. The large sized stones are rock, such as platforms etc.; edge stone is 20 inch curb, sills and jointers.

The top is of rock and slate of a very decided reddish color. This red in places runs into the bed, and a red stone is sometimes quarried, but is looked on with disfavor by the buyers. The beds are of a rather light blue color, which has a greenish tinge when dressed, or after being exposed to the weather. This greenish tinge is typical of the stone from this mountain and of the mountain to the south.

The joints run nearly north and south and east and west. The joints running north and south are known as side seams, while

the east and west joints are called headers. "Blocks" is the name for the strips of stone between the side seams. The stone is quite free from reeds and does not slake after exposure. All splitting is done along the seams. The dip of the bed is very slight on the eastern side of the mountain to the west and south; while on the southern side west and north the beds are nearly horizontal.

The texture, or grain, varies from coarse to fine. It is a usual thing to find that the top lifts of a bed are fine grained, while the bottom lift is quite coarse. The coarse grained stone is stronger and less likely to slake; and is also heavier.

The stone from the different quarries on the mountain does not vary much. The same condition and variations of texture, color, and top are met with at all levels. The quarry openings show a thickness of these alternating beds of shale, rock, and bluestone of 2000 feet. The joints are tight and loose, varying with the different openings. The side seams are in many places stained with iron.

A number of ledges with good beds of stone are exposed, but not opened, as the owners do not care to have the mountain disfigured with the rubbish piles. The top is disposed of mostly by dumping down the mountain side.

The stone is all hauled to Malden and sold to the Ulster bluestone co.

West of Dutch Settlement and West Hurley the bluestone belt widens, stretching over the 500 foot plateau which borders the mountains on the southeast. The stone from this territory is hauled to Brodhead's Bridge and other stations on the Ulster and Delaware railroad.

Beyond Brodhead's Bridge, along the Ulster and Delaware railroad, stone is quarried in the mountains as far as Grand gorge. This stone is of various colors, but is sold in the market as bluestone. The stone is shipped by way of the Ulster and Delaware railroad to Rondout, where it is loaded on barges for shipment to the eastern markets by tide water.

The quarries on the terraces between the mountains and the Highwoods district are as follows:

Hommell Bros., Fawns. Quarry is $1\frac{1}{4}$ miles northeast of West Saugerties. The bed of stone is 8 feet thick, with 15 feet of shale top. The stone is medium grain, of good blue color, but reedy. The lifts are evenly bedded, but the stone works "scallop." The product is chiefly edge stone, which is sold to Ulster bluestone co. at Malden. Two men are employed intermittently.

Hommell & Ransome, Fawns. Two men employed on same ledge. Quarry equipped with small hand derrick.

Wolven Bros., Fawns. Quarry $1\frac{1}{2}$ miles northeast of West Saugerties and $\frac{1}{2}$ mile south of Hommell Bros. The bed of stone is 4 to 5 feet thick, with 12 to 15 feet of red shale top. The stone is rather coarse grained and a good blue. The bed dips to the southwest. Side seams and heads are present and regular. These vertical joints are tight, making hard quarrying. The lifts vary from 4" to 6". Product is chiefly edge stone, which is sold to James Maxwell at Saugerties. Quarry equipment consists of a horse power pump and hand derrick. Two men are employed throughout the year.

The quarries in the vicinity of Palenville are as follows.

Sylvester Stone & Christopher Hawley, Palenville. Quarry northwest of Palenville on the mountain side at an elevation of 1160 feet. The bed of stone is 5 feet thick, with 20 feet of top, one half shale and one half rock. The stone is coarse grained and greenish blue. Some reeds are present, but split very unevenly. The lifts vary from 4" to 20". Both side seams and "headers" were present when this ledge was first opened, but the headers have run out. The bed dips to the south and west. The product is chiefly edge stone, which is hauled 13 miles to Ulster bluestone co. at Malden. Two to three men are employed. Two or three loads (3 to 4 tons each) a week are produced 8 months in the year.

Lee Wolven & Frank Simmons, Palenville. Quarry is 250 feet above Stone's. 9 feet of good stone are worked, which is cov-

ered with 18 feet of dirt and loose rock. The stone is of same quality and character as Stone's. The product is sold to Ulster bluestone co. at Malden. Two to three men are employed during the year. Three loads a week of four tons each.

Lyman Lamouree, Palenville. This quarry is 200 feet above Palenville, on the mountain side at an elevation of 780 feet. The quality of bed and character are the same as Stone's. The color is reddish. Bed is 10 feet thick with 20 feet of rock and shale top. One man employed intermittently.

Stewart & Dolan, Palenville. Two men employed very intermittently on the mountain.

P. A. Moon, Palenville. Quarry is situated just south of Otis elevated railroad, 300 feet from base of mountain. The bed is very irregular, 2 to 6 feet thick, with rock stripping of 8 feet. The product is principally flag and is a little more green than usual, but the stone is of poor quality, and the quarry is worked irregularly. Product sold to Ulster bluestone co. at Malden, and also locally. One man and one boy employed.

Frank Symmonds, Palenville. One man employed occasionally on same ledge as Moon. This bed when worked back into the mountain gives out; that is, the stone changes into "rock."

J. H. Wolven, Palenville. Quarry on north side of the Kaaterskill clove, $2\frac{3}{4}$ miles west of Palenville and 500 feet above the bottom of the clove at this point. The bed of stone is 8 feet thick, with 30 to 35 feet of top, including 7 to 8 feet of shale. The stone is of the greenish tinge characteristic of this district, and coarse grained. A few reeds are present. The lifts vary in thickness from 2" to 8". The dip of the bed here is north and west. The quarry is worked toward the north, the face running east and west. The product is hauled 15 miles to Ulster bluestone co. at Malden. A hand derrick is in use. Four men are employed during the year and six to seven loads of stone a week are drawn during eight months in the year.

The stone is comparatively soft for mill treatment, but tough, and may "chip out" under a plainer. The quarrymen say they have found streaks of coal and "shiny" in the beds. This latter

is probably pyrites. The same ledge has been opened up farther east, but is not worked there now.

Hommell & Rightmeyer, Palenville. Quarry situated on south side of Kaaterskill clove, opposite Wolven. The bed is thin, 3 feet with 12 to 15 feet of rock top. The dip is to the southwest, showing gentle roll once existed where the clove has been eroded out. The stone is coarse grained and of greenish tinge. No reeds are present and the seams are irregular. Small pockets of coal and crystals of iron pyrites are found in many of the mountain quarry beds. The stone is hauled to Ulster bluestone co. at Malden. Two men are employed eight months in the year.

Lamouree & Haines, Palenville. Quarry just west of Palenville and 500 feet above the town. The bed of stone is 7 to 8 feet thick, with 15 to 20 feet of rock top. The quality and appearance of the stone are the same as the other stone from these mountains. This has been a very productive quarry. The bed dips to the southwest. The stone is sold to Ulster bluestone co. at Malden. Two men are employed.

W. Fuller, Saxton. Quarry situated 200 feet above Haines. The bed is 20 feet thick, with rock top of 25 to 40 feet. The stone is medium grained and a fair blue color, lacking the usual greenish tinge. The side seams are straight and regular, but the heads are very irregular. The lifts vary from 3" to 10". The bed dips to the south and west. The product is sold to Ulster bluestone co. at Malden. Two men are employed.

Valk & Hommell, Palenville. Quarry near Fuller's and below it. The bed of stone is 10 feet thick, with 10 feet of rock top. The bed is quite rough and some rock is interbedded with the stone, which is of medium grain and of greenish tinge. No reeds appear. The bed dips to the south and west. Both systems of vertical jointing are present. Lifts vary from 2" to 4". The product, principally flag, is sold to Ulster bluestone co. at Malden. Two men are employed.

M. T. Wasson, Palenville. Quarry is near Valk & Hommell's. The bed of interbedded rock and stone is 12 feet thick, with rock stripping of 14 to 20 feet. This is a very small quarry and

very rough bed. The stone is of the usual character of the mountain stone, and is sold to the Ulster bluestone co. at Malden. Two men are employed.

Arbecker Bros., Palenville. Employing two men.

Howard Winne, Palenville. Employing one man. Work intermittently near Wasson's quarry.

Cook & Ransome, Palenville. Quarry 2 miles south of Palenville, 300 feet above base of mountain. The bed of stone is 8 to 10 feet thick, with rock top of 15 to 18 feet. The stone is of greenish blue color. It is coarse grained and free from reeds. The lifts vary from 2" to 4" and are rough. The systems of joining are well developed. The bed dips to the southwest. The quarry is equipped with hand derrick and siphon. The product is sold to Ulster bluestone co. at Malden. Two men are employed the year round.

The quarries in the vicinity of West Saugerties and Plaat Clove are all on the mountains at elevations varying from 400 feet to 2500 feet above the base of the mountains.

On the north side of the Plaaterskill clove the following quarries are in operation.

Hommell Bros., West Saugerties. The bed of stone is 6 feet thick, with 20 feet of rock top. The color is light blue and the grain is coarse. The lifts vary from 3" to 6", with few reeds. The bed is rather rough and uneven. Two men are employed.

Hommell & Snyder, West Saugerties. The bed of stone is 8 to 10 feet thick, with 30 to 35 feet of rock top. The stone varies in grain from fine in the top lifts to very coarse in the lower ones. The lifts vary from 4" to 20". Some reeds are present, along which the stone splits evenly and readily. The stone is blue, but has the greenish tinge typical of the mountain stone. The dip of the bed is west and south. The stone is sold to Ulster bluestone co. at Malden. Three men are employed the year round.

George Young, Plaat Clove. The bed of stone is 10 to 12 feet thick, and there are 15 feet of rock top. The stone is coarse grained and greenish blue. The bed is quite rough, and there

is a great deal of waste in quarrying. The side seams are quite irregular. The lifts vary from 3" to 12". The product includes all varieties, and is sold to James Maxwell at Saugerties. Two men are employed eight months in the year.

Wase & Burt, Plaat Clove. This quarry is $1\frac{1}{2}$ miles northwest from Plaat Clove postoffice. The bed of stone is 4 to 5 feet thick, with 12 to 15 feet of top, the most being hardpan. The stone is light blue with a greenish tinge and quite coarse grained. It is too hard for mill treatment. The vertical joining is very irregular. The lifts vary from 3" to 4". The product is chiefly thick flag, which is sold to James Maxwell at Saugerties. Two men are employed.

Schoonmaker & Young, Plaat Clove. This quarry is on the same ledge as Wase & Burt's, but the bed has thinned out to 2 $\frac{1}{2}$ feet. The character and class of stone and products are the same. The product is sold to James Maxwell. Two men are employed intermittently.

Abraham Hommell, West Saugerties. Employed in quarrying on the north side of the clove at different localities.

On the south side of the clove and on the Plaaterskill mountain the following quarries are being worked.

Delemater & Hommell, West Saugerties. The bed of stone is 12 feet thick, with 10 feet of shale and rock top. The stone is coarse grained, of good blue color and free from reeds. The lifts vary from 1" to 6". The dip of the bed is to the south and west, in contrast to the north and west dip of the beds on the north side of the clove. The vertical joints are quite irregular and stained with iron. The product is chiefly flag, which is sold to Ulster bluestone co. at Malden. Two men are employed.

Becker Bros., West Saugerties. This quarry is on the same ledge as Delemater & Hommell's. The quality of the stone is the same, though the bed and top are not so heavy, being 8 feet and 10 feet respectively. The product is sold to Hudson river bluestone co. at Saugerties. Two men are employed.

Snyder & Hommell, West Saugerties. This is on same ledge as the two previous quarries, and the quality and color of stone

are the same. The bed is 7 feet thick, with 12 feet of hardpan top. The product is sold to James Maxwell at Saugerties. Two men are employed the year round.

Erby & Egner, West Saugerties. The bed of stone is 9 to 14 feet, with a top of 50 to 65 feet of rock with shaly streaks. The stone is of fair quality regarding grain and color, and is soft enough for mill treatment. The quarry will be abandoned soon on account of the thickness of the top. The stone is sold to James Maxwell at Saugerties. Two men are employed eight months in the year.

Rightmeyer & France, West Saugerties. This quarry is on the northwest side of Plaaterskill mountain, 2300 feet above West Saugerties. The bed of stone is 5 to 6 feet thick, with 10 to 15 feet of rock top. The stone is gray and of medium grain. The seams are $\frac{3}{4}$ " to 4" apart and are very even. The product is chiefly flag, and is hauled 12 miles to James Maxwell at Saugerties. Two men are employed throughout the year.

Ethan Yeager, West Saugerties. The quarry is just being opened on the same ledge with Rightmeyer & France's quarry.

Huff & Young, West Saugerties. This quarry is also on same ledge as Rightmeyer & France's, but farther east. The dip of this ledge is southwest. Stone is the same in color and texture along the ledge, but rougher. The product of flag is sold to James Maxwell. Two men are employed throughout the year.

John Shalk, West Saugerties. This quarry is situated on south side of the Plaaterskill mountain, 2450 feet above West Saugerties. There are two beds of stone worked, separated by shale and rock. The top bed is 4 feet thick and the bottom bed 5 feet. The stripping amounts to 10 feet of rock and clay. The lifts are light, $\frac{1}{2}$ " to 5". The chief product is flag, which is sold to James Maxwell. The stone has a reddish tinge and is medium grained, and free from reeds. The seams are quite regular and smooth. One man employed.

Patrick Callahan, West Saugerties. The bed of stone is 3 feet thick, with 15 to 20 feet of rock top. The stone has a reddish tinge and is rather finer grained than the usual mountain stone.

The vertical jointing is quite irregular. The stone is carted to James Maxwell at Saugerties at an expense of $33\frac{1}{2}\%$ of the value of the load. One man is employed.

Abraham Steamburg, West Saugerties. The bed of stone is 7 feet thick with 20 feet of rock top. The stone is of the mountain character, coarse grained, reddish tinge and free from reeds. The product is all flag, and is sold to James Maxwell. Two men are employed eight months in the year.

Becker Bros., West Saugerties. The bed of stone is 5 feet thick, with 10 to 12 feet of rock top. The stone is coarse grained, of reddish tinge, and some reeds are present. The lifts vary from 2" to 3". The vertical joints are smooth and regular. The stone is soft enough to be worked in the mill. The product is chiefly flag, and is sold to different dealers at Saugerties. Two men are employed during the season.

Charles Cole, Plaat Clove. The bed of stone is 3 feet thick, with 12 to 15 feet of shaly rock top. The bed dips, as is usual in this district, to the west and south. The stone is of medium grain and reddish tinge. The product is mainly flag, as the lifts are quite thin. One to two men are employed.

Teetzel & Burt, Plaat Clove. The quarry is situated $2\frac{1}{2}$ miles west of Plaat Clove postoffice. The bed of stone is 4 feet thick, with 25 feet of rock top. The stone is light colored blue, coarse grained and free from reeds. The bed dips to the south and west. The product is principally flag, and is sold to James Maxwell at Saugerties. The quarry is equipped with hand derrick. Two men are employed.

Dale & Bunt, Plaat Clove, are just opening a quarry in this district, employing two men.

Snyder & Lindsay, Plaat Clove, are likewise opening a quarry, employing two men.

Between West Saugerties and Woodstock numerous quarries have been opened at the base of the mountains and on the eastern face. The following are operating.

Myers & Doyle, West Saugerties. This quarry is $1\frac{1}{2}$ miles southwest of West Saugerties, 1250 feet above the town. The

bed of stone is 12 to 15 feet thick, with 25 feet of red shale and clay top. The top 4 feet of bed are red stone, while the lower part is light blue. The stone is all coarse grained. The bed is rather rough and hard to work. The vertical jointing is regular and smooth. The ledge has been opened up for 300 feet along the side seams. The product includes all varieties, and is sold at Saugerties to different dealers. Three men are employed throughout the year.

Bach & Burton, West Saugerties. Quarry is $2\frac{1}{2}$ miles south of West Saugerties and 300 feet above the base of the mountain. The bed of stone is 12 to 14 feet thick, with 25 to 30 feet of shale rock and clay top. The stone is coarse grained, of light blue color and somewhat reedy. The dip of the ledge is to the south and west. The lifts vary from 2" to 14" in thickness. The thicker lifts must be split to 6", or the reeds will open. The side seams and heads are regular and open. The product consists of edge stone and rock, which is sold to Hudson river bluestone co. at Saugerties. Two men are employed.

Plass & Byer, West Saugerties. This quarry is south of Bach & Burton's and above it. The bed of stone is 6 to 7 feet thick, with a rock top of 20 feet. The stone is rather fine grained and of fair blue color. Reeds are present. "Niggerheads," or round boulders, in the bed make it hard to work. The product is principally flag, which is sold to Hudson river bluestone co. at Saugerties. Two men are employed.

Fred Snyder, West Saugerties. This quarry is situated 2 miles south of West Saugerties at the foot of the mountain. The bed of stone is 8 to 9 feet thick, with 18 to 20 feet of rock top. The stone is dark blue and rather coarse grained. The vertical jointing is rather irregular, but both systems are present. The product is sold to James Maxwell at Saugerties. The quarry is equipped with hand derrick. Three to four men are employed during the year.

Doyle & Clove, West Saugerties. This quarry is near Snyder's, but on ledge below. The bed of stone is 6 to 7 feet thick, with 10 to 15 feet of shale top. 1 to 2 feet of rock are interbedded

with the stone. The dip of the ledge is to the south and west. The stone is light blue and fine grained. Some reeds are present. The product is chiefly flag, as the lifts are light. The stone is sold at Saugerties to various dealers. Two men are employed throughout the year.

Albert Doyle, West Saugerties. Two men are employed in quarrying on the same ledge as Doyle & Clove, just south.

Oliver Holden, West Saugerties. The bed of stone is 15 feet thick, but on account of rough streaks there is a large amount of waste. 15 feet of shale cover the bed. The stone is of medium grain, fair blue color and reedy. This ledge has been opened for 250 feet in a north and south direction. The dip is to the west and south. The product is sold to the Hudson river bluestone co. at Saugerties. Four to five men are employed during the year.

Lawrence Wolven, West Saugerties. This quarry is on the same ledge as Holden's, but south. The bed is but 4 feet thick here, with 10 to 12 feet of shale top. The bed is badly broken up, but the stone is of the same character as Holden's. The joints are open 3" to 4". Two men are employed the year round.

In the vicinity of Daisy several small quarries have been opened.

Burton Bros., Daisy. Quarry is situated $\frac{1}{2}$ mile south of Daisy. The bed of stone is 8 to 10 feet thick, with a rock top 10 to 20 feet thick. The stone is quite dark blue and of medium grain. The ledge has been opened 300 feet along the strike. The bed dips to the north and west. A stratum of shale appears between the bed and top rock. The thickness varies from 1 to 4 feet. The lifts vary from 3" to 10". The product, of various varieties, is sold to James Maxwell at Saugerties. Three men are employed.

The following operators also quarry on this ledge.

Abraham Cole & Son, Daisy. Two men employed throughout the year.

John Van Etten & Son, Daisy. Two men employed.

Peter Mower, Daisy. One man employed.

Ellis Wolven, Woodstock. Quarry is situated $1\frac{1}{2}$ miles southwest of Daisy, and $1\frac{1}{2}$ miles east of Woodstock. The quarry is a pit in the open field. The thickness of bed is 4 to 5 feet, with 1 to 2 feet of rock and 6 to 7 feet of clay top. The stone is dark blue and rather fine grained, and reeds are present in top lifts. The dip of the bed is to the northwest. The lifts vary from 3" to 22". The product is chiefly edge stone, which is sold to Ulster bluestone co. at Malden. Three to four men are employed during the year.

In the vicinity of Woodstock the following operators are working.

N. Mower, Woodstock. Quarry is on a ledge (1 mile east of Woodstock) which has been opened for some length. The bed of stone is very rough and 2 to 4 feet thick. The overburden is 8 to 10 feet of rock. The dip is to the west and north. The stone is fine grained in upper lifts and coarse in lower. It is of good blue color. The vertical joints are somewhat irregular and stained with iron. The product is sold to James Maxwell at Saugerties. The quarry is worked intermittently by two men.

Canine & Longendyke, Woodstock. Quarry on same ledge as Mower's. Two men employed intermittently.

Egbert Schoonmaker, Woodstock. Quarry is situated $\frac{1}{2}$ mile east of Woodstock. The bed of stone is 6 to 7 feet thick, with 4 to 5 feet of rock and clay top. The bed is very irregular and dips rather sharply to the north and west. Water collects at the lower end and is drained by a siphon. The stone is medium grained and of dark blue color. Some pyrites is found in the bed and affects color of stone on exposure. The lifts vary from 2" to 12", and all varieties of stone are produced, and sold to James Maxwell at Saugerties. Two men employed during the year.

Levi Mann, Woodstock. Quarry situated $\frac{1}{2}$ mile north of Woodstock. The bed of stone is 3 feet thick on an average, but is very irregular and rough. The top is of rock 8 feet thick. The stone is fine grained and reedy. The bed dips to the north

and west at changing angles. The product of edge stone and rock is sold to James Maxwell. Two men are employed intermittently.

On the southeastern side of Overlook mountain several ledges have been opened and worked extensively. The quarries known as the "California" quarries were very productive, but have not been worked in some years on account of the very heavy top. The same ledge, however, has been opened to the north, and five different firms are quarrying. The bed of stone is 11 to 13 feet thick, with 18 to 30 feet of rock top. The stone is fine grained, reedy and of light blue color. The top lifts have a reddish tinge. The stone is split into thin layers, for, if left thick, the reeds weather open. The ledge dips to the west and north. The product, chiefly of flag, is sold to Hudson river bluestone co. and to James Maxwell.

The following are the operators, all of Woodstock.

M. Elliott. Four men employed.

McGhee & Waste. Three men employed.

McGhee & Herrick. Four men employed.

Edward McGhee. Four men employed. The quarry equipped with hand derrick.

Peter Keegan. Three men employed.

James Riley. This quarry is on a ledge below Elliott's. The bed of stone is 7 to 8 feet thick, with 10 to 15 feet of rock top, 4 feet of which are slaty. A shale parting appears between stone and rock. The stone is of medium grain, light blue and reedy. The lifts vary from 5" to 6". The bed dips gently to the north and west. Both systems of vertical jointing appear. The product is sold to James Maxwell at Saugerties. Four men are employed.

Whittaker Bros., employing two men and **Jack Murray** employing one, have small quarries on the side of Overlook mountain.

In the vicinity of Bearsville, 2 miles west of Woodstock, the following quarries are in operation.

Charles Yerry, Bearsville. Quarry 1 mile southwest of Bearsville on the side of the hill. The bed of stone is 6 to 7 feet thick,

with 12 feet of rock top. The stone is of fairly good color and medium grain. The quarry has been extensively worked. The dip of the bed is to the north and west. The upper lifts produce flag and the lower ones edge stone, all of which is sold to Hudson river bluestone co. at Saugerties. The vertical jointing is quite irregular. One man employed intermittently.

Snake rock quarries

These quarries are on a low hill $1\frac{1}{4}$ miles south of Bearsville. The ledge has been opened 800 feet around the hill. The bed of stone is 10 to 12 feet thick, with 30 feet of rock top. The stone is of medium grain and fairly good blue color with a reddish tinge. The lifts are rather heavy, and the product consists of rock and edge stone. The bed dips to the north and west. The vertical jointing is regular and smooth. What water collects at the lowest point is drained by a siphon. The product is sold to Hewitt Boice at Kingston, and to the Hudson river bluestone co. at Saugerties. The cost of haulage is 50% of value of load.

The following are the operators.

Oscar Lasher, Woodstock. Five to six men employed during the season. Quarry equipped with derrick.

Brower & De Graff, Glenford. Three men employed during the year.

Stoutenburgh & De Graff, Glenford. Three to four men employed.

Stratton & Davis, Woodstock. Two men employed.

Bonsteil Bros., Woodstock. Two men employed.

John Hasenpflug, Glenford. This quarry is on ledge below the above quarries. The bed of stone is 4 to 5 feet thick, with 25 feet of rock top. The stone is of the same character as the ledge above. The lifts vary from 3" to 8". The product is mainly rock, which is sold to Hewitt Boice at Kingston. One man employed.

Flowers & Brower, Glenford. Quarry is situated on same ledge as Hasenpflug. Two men employed.

A. E. Shultis, Bearsville. Quarry situated 2 miles west of Bearsville. The bed of stone is 6 feet thick, with 8 to 9 feet of rock top. Red shale appears in top also. The stone is fine grained and of poor blue color. The bed dips to the west and north. The lifts are light, the product being nearly all flag. Two men are employed occasionally.

Samuel Shultis, Bearsville. This quarry is just west of Shady postoffice on the hillside 200 feet above the town. It is on a ledge which has been opened up in numerous places. The bed of stone is 6 to 8 feet thick, with 15 to 20 feet of top, mostly of red shale. The stone is fine grained, reedy and of poor color. The product is mainly flag. Three men employed.

George Leppo jr, Shady postoffice. Quarry $2\frac{1}{2}$ miles north of Shady. The bed of stone is 4 to 5 feet thick, with top of rock varying in thickness from 4 to 15 feet. The stone is coarse grained and light blue in color. The lifts vary from 1" to 3", the chief product being flag. The stone is hauled to Wilbur, 20 miles distant, and sold to Hudson river bluestone co. Three men are employed.

George Leppo sr, Shady postoffice. Quarry is $\frac{1}{4}$ mile northeast of that of George Leppo jr. The bed of stone is 6 to 7 feet thick, with 10 to 15 feet of rock top. The stone is of the same character as that just described. All varieties are produced, and sold to James Maxwell at Saugerties. Three men are employed.

Henry Carle, Lake Hill. Quarry is 1 mile north of Lake Hill in Mink hollow. The bed of stone is 4 feet thick, with 12 feet of rock top. The stone is of coarse grain and fair color. Some reeds are present, but they are very tight. The lifts are very heavy, 6" to 12". The stone was used for the Cooper lake reservoir dam. The lifts are too heavy for flag or edge stone. The face of the quarry runs north and south, and at the northern end the dip of the bed is to the north, while at the southern end the dip is to the south, showing a roll in the middle. Four men are employed intermittently.

C. Shultis, Willow postoffice. Quarry 2 miles north of Willow postoffice. The quarry is very small, the bed of stone being 4

feet thick, with 8 feet of rock top. The stone is fine grained and reedy, and is sold as flag to Hudson river bluestone co. at Saugerties, 21 miles distant. Two men are employed.

In the vicinity of Glenford the following quarries are in operation.

E. Miller, West Hurley. The quarry is 2 miles north of Glenford. The bed of stone is 3 to 4 feet thick, with 12 to 15 feet of rock top. The stone is coarse grained and of good blue color, and a few reeds are present. The dip of the ledge is to the west and south. The lifts vary from 5" to 18" in thickness. The vertical joints are regular, but tight. The stone is sold to Julius Osterhoudt at Wilbur. Three men are employed.

John Jones, Woodstock. Quarry is on ledge 200 feet above Miller's quarry. The bed of stone is 5 to 6 feet thick, with 20 feet of top, 7 feet of which are rock, the balance shale. The stone is fine grained, of fair blue color and so reedy that the lifts have to be split thin to insure the stability of the stone. The thickness of the lifts varies from 3" to 6". The bed dips to the west and north. The product of flagstone is sold to Hudson river bluestone co. at Saugerties. Three men are employed.

Abraham Van Etten, Woodstock. The quarry is very small and is 2 miles northeast of Glenford. The bed of stone is 4 feet thick, with 10 to 12 feet of rock. The stone is fine grained, light blue and reedy. The product is principally flag. Two men are employed during the year.

Philip Brower, Glenford. Quarry 1 mile west of Glenford. The bed of stone is 5 to 6 feet thick, with 8 to 10 feet of interbedded shale and rock. The stone is of medium grain and good color. The bed is very irregular, and the dip is to the north and west. The vertical joints are regular and smooth. The product is sold to Rogers & Tappan at Wilbur. Two men are employed.

Kittle & Co., Glenford. Quarry situated $1\frac{3}{4}$ miles west of Glenford and just being opened. Four men are employed.

John Gross, Glenford. Quarry is $1\frac{1}{2}$ miles west of Glenford. The bed of stone is 10 feet thick, with a rough streak $1\frac{1}{2}$ feet thick in center of bed. The top consists of 13 feet of rock and

7 to 8 feet of clay. The lifts vary from 2" to 7". The stone is of medium grain, a dull blue color, and reedy. The product includes all varieties of edge stone and is hauled to Wilbur, 12 miles distant, at a cost of 90c a ton. Two men employed.

Wallace Grey, Glenford. The quarry is situated on hill 1 mile north of Glenford. The bed of stone is 7 to 8 feet thick, with a rock top of 20 feet. The stone is of good blue color, of medium grain, and reedy. The product is sold at Wilbur to various dealers. One man is employed.

Burkins & Flowers, Glenford. Quarry is $\frac{1}{2}$ mile northeast of Glenford. The bed of stone is 10 feet thick, with 10 to 12 feet of rock overburden. The bed is somewhat rough, but the stone is of fair quality, fine grained and blue. Some reeds are present. The dip of the ledge is to the north and west. All varieties of stone are produced and sold to Rogers & Tappan at Wilbur. Two men are employed.

Johnson & Piert, Glenford. This quarry is situated on same ledge as Burkins & Flowers's. Two men are employed.

McAuliffe & Terwilliger, Ashton. Quarry is situated just north of Temple pond and 2 miles southwest of Glenford. The bed of stone is 7 to 8 feet thick, but stone and rock are interbedded, causing a great deal of waste. The top consists of soil and rock 2 to 3 feet thick. The stone is of medium grain, of dark blue color, and free from reeds. The lifts vary from 1" to 5". The dip of the bed is gentle to the north and west. The side seams are uniform and smooth, but the heads are quite irregular. The product is flag and edge stone, and is sold to Rogers & Tappan at Wilbur. Two to four men are employed.

Ostrander & Brower, Glenford, two men employed, and **D. E. Hyatt, Ashton,** one man employed, also quarry on this ledge adjoining McAuliffe & Terwilliger's.

David Firman, Shokan. Quarry 1 mile northwest of Temple pond on hillside. The bed of stone is 6 feet thick, with 10 to 12 feet of rock stripping. The dip of the bed is to the west and north. The vertical jointing is irregular. The stone is fine grained and of good blue color. One man is employed.

Robert Secor, Olive. One man employed on ledge adjoining Firman's.

John Russell, Ashton. Quarry is on ledge below Firman's. The bed of stone is 5 to 6 feet thick, with 5 to 7 feet of rock and clay top. The quarry is just opened. The grain of the stone is medium, and the color blue. One man employed.

Chase & Barclay, Ashton. Quarry situated 2 miles east of Boiceville. The bed of stone is 4 to 5 feet thick, with 10 to 15 feet of rock top. The bed dips very gently to the north and west. The stone is very dark blue, fine grained and reedy. The side seams and heads are well developed. The product is chiefly flag, which is sold to different dealers at Wilbur. Two men are employed.

Oliver Hughes, Ashton. Quarry situated 1 mile northeast of Ashton postoffice. The bed of stone is 4 to 5 feet thick, with rough streaks in it. The top is 4 feet thick and is of rock. The stone is fine grained, a good blue and free from reeds. The dip is to the west and south. The product is chiefly flag, which is sold to Rogers & Tappan at Wilbur. The cost of cartage is 85¢ a ton. One man employed intermittently.

Jones & Co., Ashton. Three men employed in quarry adjoining Hughes's on same ledge.

Greene & De Graffe, Ashton. Quarry 3 miles east of Ashton postoffice. The bed of stone is 4 feet thick, with 8 to 9 feet of rock and 1 foot of clay top. Streaks of shale appear in bed, which is rather rough. The dip is to the west and south. The stone is fine grained and of good blue color. The lifts vary from 2" to 6". The product is chiefly flag, and is sold to Rogers & Tappan at Wilbur. Two men are employed.

Hewitt Boice has a mill and dock at Brodhead's Bridge, and the stone from the territory south is hauled there. The prices paid the quarrymen are 15¢ to 20¢ lower than at the river docks, on account of the extra cost of freight to Rondout, which is 90¢ a ton. The quarries follow.

Beesmer & Hover, Olivebridge. Quarry situated $\frac{1}{2}$ mile south-east of Olivebridge. The quarry is just opened. The bed is 4

feet thick, with 7 to 8 feet of rock stripping. The stone is of medium grain and good blue color. The product is sold to Hewitt Boice at Brodhead's Bridge. The quarry is equipped with hand derrick. Three men employed.

Van Kleek & Dudrey, Brodhead's Bridge. The quarry is on south side of Esopus creek, $\frac{1}{4}$ mile from Olivebridge. The workable bed of stone varies in thickness from 6 to 10 feet. A rough streak appears 3 feet below top of bed. The rubbish is dumped into the bed of the creek. The stripping is of rock 5 to 8 feet thick and 1 to 2 feet of soil. The stone is fine grained and of poor blue color. The vertical joints are uneven and stained with iron. The product is sold to H. Boice at Brodhead's Bridge. Two men are employed.

Eckert & Beesmer, Olivebridge. Two men employed.

Barton & Lyons, Olivebridge. Quarry on the ledge adjoining Van Kleek & Dudrey's, two men employed.

Aaron Bishop, Olivebridge. Quarry 1 mile southeast of Olivebridge. The bed of stone is 10 feet thick, with rock top of 14 feet. The dip of the bed is to the north and west. The stone is of medium grain and good blue color. The quarry is equipped with hand derrick. The product is sold to H. Boice at Brodhead's Bridge. Two men employed.

Howard Barton, Olivebridge. Quarry is situated on ledge above Bishop's. The bed of stone is 5 to 6 feet thick, with 15 feet of stripping of shale and clay. The stone is fine grained and of good blue color, but has a reputation for slaking. The product is sold to Hudson river bluestone co. at Wilbur. Two men are employed.

Dudley & North, Olivebridge. Quarry on ledge below Bishop's. The bed of stone is 2 to 3 feet thick, with 4 to 5 feet of stripping. The stone is of same quality as Bishop's. The product is chiefly flag, and is sold to H. Boice at Brodhead's Bridge. Two men employed.

Cornish & Bush, Olivebridge. Quarry is 3 miles southeast of Olivebridge. The bed of stone is 3 feet thick, with 5 feet of rock top. The stone is of ordinary quality and runs in heavy

lifts. The product is chiefly rock, and is sold at Brodhead's Bridge and Kingston. Two men employed intermittently.

George Winne, Olivebridge. Quarry $3\frac{1}{2}$ miles southeast of Olivebridge. Bed of stone is 5 feet thick, with 12 feet of rock top. The quality of the stone is ordinary. The bed is about worked out. The product is carted to Brodhead's Bridge. Quarry is equipped with hand derrick. Two men employed intermittently.

A. Barton, Olivebridge. Quarry 4 miles southeast of Olivebridge. The bed of stone is 4 to 5 feet thick, with a rock top of 8 feet, and 2 feet of clay additional. The quality of the stone is common. The lifts vary from 2" to 10". The dip of the bed is to the north and west. The vertical joints are uniform and smooth. The product includes all varieties, and is sold to H. Boice at Brodhead's Bridge. Quarry is equipped with horse power derrick. Three men are employed during the year.

Merrihew ledge

This ledge is situated $4\frac{1}{2}$ miles south of Olivebridge and has been opened up 500 feet in an east and west direction. A large amount of stone has been produced, but the top is becoming too heavy for profitable work. The bed of stone is 4 to 5 feet thick, with 7 to 8 feet of rock, and 5 to 6 feet of clay overburden. The stone is close grained and of fair blue color. Few reeds appear in the lifts, which vary 2" to 6". The bed dips to the north and west gently. The systems of jointing are well developed in the ledge. The product includes all varieties of marketable stone. The following are the operators, all of Olivebridge.

Resne & Keator. Two men employed nine months in the year.

Ezra Palen. One man employed.

Carson & Merrihew. Two men employed.

Christiana & Beesmer. Two men employed.

G. De Witt. One man employed.

Egbert Van Kleek, Olivebridge. The quarry is situated $2\frac{1}{2}$ miles southwest of Olivebridge. The bed of stone is 4 feet thick, with

12 to 15 feet of shale and rock top. The stone is of fair quality and comparatively free from reeds. The product is chiefly rock, which is sold to H. Boice at Brodhead's Bridge. One man is employed intermittently.

Michael Riley, Olivebridge. This quarry is 4 miles southwest of Olivebridge. There are three distinct beds of stone worked in this quarry, divided by shale. The top is of shale 14 feet thick, below which the first bed is 3 feet thick. A bed of shale $3\frac{1}{2}$ feet thick separates this from the second bed which is 3 feet thick. Another bed of shale 4 feet thick separates the second from the third bed, which is 6 feet in thickness. The stone is fine grained and of good color. Some reeds are present. The bedding planes are very smooth and regular. No heads appear in the quarry, but the side seams are uniform. The product is chiefly rock, which is sold to H. Boice at Brodhead's Bridge. Four men are employed the year round.

George Chambers, Samsonville. A small quarry east of Samsonville. The bed of stone is 4 feet thick, with rock top of 10 to 12 feet. The dip is to the north and west. The stone is of ordinary quality. The product is sold at Brodhead's Bridge to H. Boice. One man is employed intermittently.

List of buyers on the Hudson river¹

Hewitt Boice, Kingston

Three yards and mills at Rondout, Kingston and Brodhead's Bridge.

Rondout. There is a mill with three planers, two gang saws, one rubbing bed, one borer. The dock is equipped with four steam power derricks and a blacksmith shop.

Kingston. Dock is on Ulster and Delaware railroad, and is equipped with mill with three planers, three gang saws and one rubbing bed. Two steam derricks are in use in the yard.

Brodhead's Bridge. The mill is equipped with two planers and two gang saws. Two steam hoisting derricks are in use. Em-

¹For a statement of the present administrative conditions of the bluestone industry in this region and its consolidation under "Hudson river bluestone co." on Mar. 1, 1901, see p. 104.

ployees in three yards, 90. Five barges and one schooner are in use for transporting the stone to market.

Value of business per year, \$300,000 to \$350,000 (estimated).

Hudson river bluestone co. Rondout

Docks at Malden, Saugerties, Glasco, Rondout and Wilbur, with mill equipment as follows:

Malden. Eight saws, eight planers, two rubbing beds, two boring machines, five steam derricks.

Rondout. Eight saws, nine planers, two rubbing beds, one boring machine, two steam derricks, one traveling crane.

Wilbur. Four saws, six planers, two rubbing beds, one boring machine, four steam derricks.

Employ about 200 men yearly and operate 15 barges.

Value of business, about \$500,000.

Julius Osterhoudt, Rondout

Docks at Wilbur and High Falls.

Wilbur. The mill is equipped with three gang saws, one rubbing bed, three planers and one boring machine. Three steam power derricks are in use on the dock. 40 employees.

High Falls. One hand power derrick is in use. Four employees.

Five barges and one schooner are used for transportation.

Value of business per year, \$175,000.

Ulster bluestone co. Malden

Docks at Malden and Glasco.

Malden. Mill is equipped with 10 saws, eight planers, two rubbing beds and one borer. 50 men are employed. Five steam derricks are in use in the yard.

Glasco. One hand derrick is the equipment. Three employees. Four barges are in use.

Value of business per year, \$250,000 to \$350,000 (estimated).

James Maxwell, Saugerties

Docks at Saugerties and Glasco. No mill at either place. One hand derrick at Saugerties. 20 employees.

Condition of the bluestone industry in Ulster county

The quarries within easy hauling distance of the river docks are becoming worked out. This does not mean that the beds of stone are worked out in all cases, but the stripping in many places has become so heavy that no profit is left to the quarrymen after paying rental and cartage. The beds dip to the west at a small angle 5° to 6° , and, with the crude methods used when the top reaches a thickness $2\frac{1}{2}$ to 3 times (with a few exceptions) that of the bed of stone, the profit vanishes. The workable beds are also limited in extent. This is true in both the two main districts. Probably in the vicinity of Saugerties, the most productive district, not one half as many men as formerly are working now. A great many of the quarrymen have gone back to the mountains or along the Ulster & Delaware railroad, or into Delaware, Broome and Sullivan counties. The cost of cartage from the mountains to the river is very high, running up to 50% of the value of a load. Freight on the Ulster & Delaware railroad is also quite high.

QUARRIES IN BROOME, DELAWARE AND SULLIVAN COUNTIES

The quarries in these counties have been opened on the hill-sides, on both banks of the Delaware river in New York and Pennsylvania, as far north as Tuscarora in Broome county, and south to Pond Eddy in Sullivan county.

The product of these quarries reaches the market by the way of the Erie railroad. Bluestone is also quarried along the main line of the Ontario and Western railroad from Franklin Depot in Delaware county to Hurleyville in Sullivan county, and along the Port Jervis and Monticello railroad.

A few quarries have been opened along the Delhi branch of the Ontario and Western railroad. Switches have been put in at convenient points on the lines of the railroads for shipping the stone. The buyers have small docks at these switches. Few mills are established in this district, the rock for mill treatment being shipped in the rough to mills nearer the markets.

The stone quarried in these counties differs from the Ulster county product in several characteristics. It is softer, it

works east and west instead of north and south. It is coarser grained. The color is not so good, tending toward a gray. It is less liable to slaking, and fewer reeds are found in the lifts.

The ledges of stone are more pockety than the Ulster county stone. The vertical jointing is more irregular, specially the east and west joints. Less shale is found in the stripping, and the dip is not persistent in any one direction.

The quarries have nearly all been opened high up on the hills; so the drainage is natural. "Black jack" and "sap" are peculiarities of these quarries alone. "Sap" rock is the discolored greenish gray stone which is near the joints. The discoloration extends into the bed from 1 to 3 feet on each side of the joint. "Black jack" is a soft, claylike material, which occurs in the ledges in lens-shaped forms. It crumbles under the hand and contains a great deal of iron. It is due to an alteration of the rock, and when occurring may, as the quarrymen say, "eat out" the whole bed and ruin the quarry.

The prices paid the quarrymen are much lower than at the docks on the Hudson, because of the difference in cost of transportation to market. But the proximity of the railroads lessens the cartage charges.

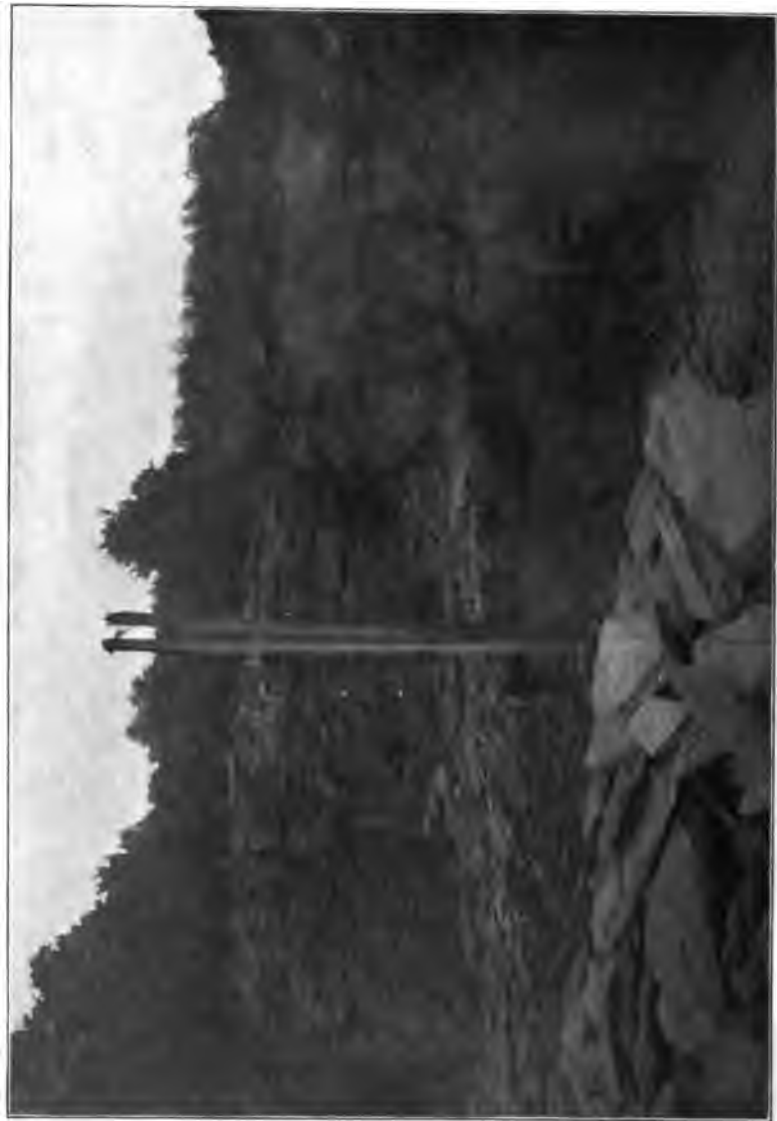
In the isolated districts business seems to be in a fair condition, with an active demand at Oxford.

Quarries in Delaware, Sullivan and Broome counties

Deyo & Son, Franklin Depot. Quarry is situated $1\frac{1}{4}$ miles west of Merriekville station on the Ontario and Western railroad and $\frac{1}{4}$ of a mile east of Franklin Depot.

Vertical section shows

Soil	2 feet
Stone	2 feet
"	2 feet
Rock	1 foot
Stone	2 feet
Shale	6"
Rock	$2\frac{1}{2}$ feet
Stone	5 feet



H. T. Dickinson, photo. Bluestone quarry of Henry St John, 1 mile east of Walton N. Y.



H. T. Dickinson, photo.

Bluestone quarry of Frank Bond in Oxbow hollow, $3\frac{1}{4}$ miles from Walton N. Y.



H. T. Dickinson, photo.

Bluestone quarry of George Davis, $2\frac{1}{2}$ miles east of Walton N. Y.

This section is taken at the point where the face is at its maximum height. The face is 600 feet long. The system of jointing is the same as in Ulster county, and regular. The stone is medium fine grained, of light blue color with greenish tinge, and free from reeds. The lifts vary in thickness from 1" to 7" and are smooth and even. The bed dips slightly to the south and east. The stone is rather soft and is suitable for mill work. The product is chiefly flag and large rock, which is sold by Deyo & Son directly to dealers in Weehawken and local dealers.

The stone is shipped from the Merrickville station of the Ontario and Western railroad at a cost of \$1.75 a ton to Weehawken. Four men are employed during the quarrying season of eight to nine months. The quarry has been open seven years.

In the vicinity of Walton the following quarries are in operation.

George Davis, Walton. Quarry is on west side of Marvin hollow, $2\frac{1}{2}$ miles east of Walton. The bed of stone is 10 to 12 feet thick, with 14 feet of rock and 3 feet of soil overburden. The bed is horizontal and with even lifts, which vary from 1" to 11" in thickness. The vertical joints are rough and irregular. The stone is of medium grain and gray blue, when not discolored from sap near the joints. Some reeds are present, which are used in splitting the stone. The product includes flag edge stone and rock, which is sold to dealers at Weehawken. 50 to 60 cars a year are shipped during the season. Three men are employed. A hand derrick is in use.

Frank Bond, Walton. Quarry is situated in Oxbow hollow on the eastern side, $4\frac{1}{2}$ miles east of Walton. The quarry is on ledge showing bed of stone 8 to 10 feet thick, with 25 to 35 feet of rock and 5 feet of earth top. The stone is light blue, fine grained and even bedded, with lifts varying from 2" to 7". Side seams are prominent, but not exactly vertical. The headers are few. The bed is horizontal. The product is flag and platform, and is shipped at Colchester Station on the Delhi branch of the Ontario and Western railroad. A hand derrick is part of the equipment. Two to three men are employed.

Ralph Cairns, Walton. Quarry is situated on south side of west branch of Delaware river, $1\frac{1}{2}$ miles east of Colchester Station. This quarry was operated for a number of years and abandoned. Cairns began operations last year. The ledge has been opened up for 900 feet in an east and west direction. The face shows a maximum height of 55 feet, 30 feet of shale and rock at the top. Bed of stone 8 to 10 feet, 2 to 3 feet of shale, and bottom bed of stone 10 to 11 feet thick. The characteristics of the stone vary with its position in the bed. At the eastern end of the quarry the top bed is red and thin bedded, while at western end the stone from the top bed is blue and the lifts are thicker. The lower bed is fairly regular throughout in regard to color and grain, but the stone from it in the eastern end has few reeds and is hard to split, while at the western end the stone is reedy and splits easily and well.

The western end of the quarry has not been opened up as deeply as the eastern end. The bluestone has a greenish tinge and is of medium fine grain. The lifts vary from 2" to 22". The product includes flag, edge stone and rock, which is shipped at Colchester Station on the Ontario and Western railroad (Delhi branch). The quarry is equipped with two hand derricks. Three men are employed.

William Cairns, Walton. Quarry situated on south side of West branch of Delaware river, $2\frac{1}{2}$ miles east of Walton, in same range as Ralph Cairns's quarry. The bed of stone is 9 feet thick, with 22 to 23 feet of rock stripping. The dip is a gentle one to the west. The face has a length of 500 feet. The two systems of vertical jointing are well developed. The stone is medium fine grained, light blue and somewhat reedy. The product is shipped at Colchester Station. The cost of cartage is 90c a load. 25 cars were shipped during the past season. The quarry is equipped with a hand derrick, and four men are employed.

J. Merritt, Hamden. Quarry is 2 miles south of Hamden on hillside. It is small and is worked intermittently only. The bed of stone is 8 to 9 feet thick, with 6 feet of rock and 12 to 15

Plate 10



H. T. Dickinson, photo.

Bluestone quarry of J. Merritt, 2 miles south of Hamden N. Y.





H. T. Dickinson, photo.

Bluestone quarry of I. J. Moore, Pine creek south of Walton N. Y.





H. T. Dickinson, photo.
Bluestone quarry of W. G. Underwood on N. Y. O. & W. R. R. between
Cadosia and Rock Rift N. Y. This is a new opening and shows
a 3 foot bed of clay between two beds of stone

feet of dirt top. The bed is irregular and horizontal. It is divided by irregular vertical joints. The stone is fine grained and gray blue. The product is shipped at Hamden on the Ontario and Western railroad (Delhi branch).

A small quarry has been opened at Delhi for the local market. It is worked intermittently only.

I. J. Moore, Pineville. Quarry in Pine brook hollow 3 miles west of Walton. The stripping of rock and clay is 4 to 15 feet thick, and covers a bed of stone which is coarse grained and bluish gray, 5 feet thick. The lifts vary from 2" to 6", the lower ones being quite rough. The vertical jointing is quite irregular. The stone is shipped at Pine switch on the Ontario and Western railroad to Schenectady. Three to four men are employed.

Ellsworth Huntington, Rock Rift. Quarry is situated above Draper's switch 2 miles north of Apex. The ledge has been opened around the hill for 300 feet. The bed of workable stone is 12 feet thick, with 12 to 14 feet of rock top. The stone is greenish gray and coarse grained. The bed is divided by the usual joints, which are regular and smooth. It dips to the northeast 14 inches in 20 feet. The lifts vary from 2' to 12'. The product includes flag, curb, steps, etc. 30 to 40 cars are shipped each year to various points. Three to four men are employed.

T. Slossenburg, Hancock. Quarry is just west of Kerry switch, 4 miles north of Cadosia on Ontario and Western railroad. The quarry is small and not worked regularly. The bed exposed is 4 feet thick, with 12 feet of rock stripping. The stone is thin bedded, coarse grained and of gray color. The bed dips gently to the west. The face along the side seam is 75 feet long. Flag is the product, and is shipped at Kerry switch by way of the Ontario and Western railroad.

W. G. Underwood, Hancock. This quarry is just south of and on ledge below Slossenburg's. The quarry is just being opened and shows 2 beds of stone, 2 and 6 feet thick, separated by a stratum of earth 3 feet thick. The probable explanation of this is that the top bed has been broken off the main ledge and

shoved outward on the drift earth above the lower bed. The stone is greenish gray and coarse grained. The product is chiefly flag, which is carted to Kerry switch. Four men are employed.

Peter Fritz, Hancock. Quarry is $\frac{1}{4}$ of a mile northwest of Cadosia on west side of valley. The bed of stone of 20 feet has a rock and clay top 30 to 35 feet thick. The stone is of medium grain and reedy. The face is 250 feet long in the direction of the side seams, which are irregular. The lifts vary from 4" to 12". The bed dips to the west. The product of flag and edge stone is sold to Kirkpatrick at Hancock.

E. J. Cotter, Hancock. Quarry situated 2 miles east of Hancock on north side of East branch of Delaware river. The quarry is rated as being one of the best in the district. The product is nearly all sold as rock to mills at different places near New York. It is shipped by the Ontario and Western railroad from Gravel bank switch. 65 to 70 carloads are shipped each year. The bed of stone is 17 feet thick, with rock top of 35 to 50 feet. The bed is divided by the regular jointing systems. The side seams are regular, but the headers are not. The lifts vary from 2" to 4", depending on the block. The stone is bluish gray except where stained with sap, where it is greenish gray. The grain is medium fine. The quarry is equipped with hand derrick. Six to 10 men are employed.

Roy Wheeler, Hancock. Quarry is 2 miles east of Cadosia on south side of East branch of Delaware river. The top is 10 to 15 feet thick and of thin bedded rock. The bed is 6 feet thick and dips to the south gently. The lifts are $1\frac{1}{2}$ " to 3" thick and very even and smooth. The side seams are uniform, but the headers are irregular. The ledge has been opened up 200 feet along the line of the headers. The stone is coarse grained and greenish blue gray. Flag is the main product, and is sold at the Tunnel switch on the Ontario and Western railroad to Randall Bros. Three men are employed.

Leahey Bros., Hancock. Quarry 3 miles east of Cadosia, 15 feet above the East branch of Delaware river. The quality of

the stone is very fair. It is grayish blue and fine grained. The bed is 25 feet thick, with 45 feet of rock top. The bed is horizontal and at east end of quarry is very rough. The side seams are regular, but head-offs are not. The lifts vary from 2' to 20'. Some reeds are present. The product is chiefly flag, and is hauled to Tunnel switch on the Ontario and Western railroad, where it is sold to Randall Bros. 20% of the value of each load is paid for cartage. Two men are employed.

James Nevins & Sons, Fish Eddy. This firm has a mill at Tyler's switch between Fish Eddy and Hancock, where it saws, planes and rubs the product of its quarry, which is 1 mile north-west of the mill on the hillside. The mill is equipped with three gang saws, two diamond saws, two planers, and two rubbing beds. Three derricks (two fitted for steam power) are in use. 10 men are employed nine months in the year in the mill. 50 cars a year of dressed stone are shipped, principally to New York. The apartment house in New York on 10th avenue, between 57th and 58th streets, is an example of the construction of this stone. The chief product of the mill is finely dressed house trimmings, steps and platforms. The mill was formerly near Walton. The quarry is operated by contract by Irving Carver, who is paid 2½c an inch thick per square foot for rock quarried, and 45c a cubic yard for stripping. The bed of stone is 16 feet thick, with 30 to 35 feet of rock stripping. The stone is of medium grain, gray blue color and rather soft. The bed is horizontal, and divided by irregular vertical joints. Black jack occurs in the bed in spots. The quarry is equipped with hand derrick, steam boiler and drill. Three to four men are employed.

Christopher Proskine, Fish Eddy. Quarry is situated 1½ miles east of Fish Eddy. The opening is very small and shows 4 feet of bed, with 10 to 12 feet of rock top. Cross bedding appears in the ledge, causing waste. The stone is coarse grained and blue gray, and is quarried for flagging. The stone is hauled to Fish Eddy and shipped by the Ontario and Western railroad.

G. W. Swartwout, Read Creek. Quarry situated on hillside on west side of Delaware river (East Branch), 2 miles north of Fish Eddy. The ledge has been opened 250 feet in the direction of the side seams, which are irregular. The bed of stone is 4 to 5 feet thick, with rock top of 20 feet. The stone is coarse grained and gray blue. Much of it is stained with sap. The bed dips to the south and west. The lifts are 2" to 2½" thick, producing flag chiefly, which is shipped at Fish Eddy. Two to three men are employed intermittently.

Sydney Skinner, East Branch. This quarry is on hill across the river from Swartwout's. The quarry is very small and is just being opened. 3 feet of bed are exposed, with 6" of shale and 6" of clay top. The bed is horizontal, and the seams are 2" to 3" apart. The stone is of medium coarse grain and greenish gray color. Below the bed a rough streak occurs. The product of flag is hauled to East Branch and sold to Rhodes.

This is as far south on the line of the Ontario and Western railroad as the quarries were visited. A few other quarries are being worked near East Branch.

As before remarked, there are a number of quarries at Deposit that were not seen. The description of those that were visited follows.

S. F. Whittaker & Co., Deposit. Quarry is 2½ miles south of Deposit on west side of Delaware river in Broome county. The face along the side seams is 600 feet long and at the maximum height is 35 feet, of which 7 feet are workable stone. The stripping of 12 to 28 feet is rock, shale and earth. The stone is of medium grain and rather dark blue color. Some reeds are present. The bed dips to the southwest at a noticeable angle. The product is sold to Deposit stone co. Three to four men are employed during the season.

Charles Linkroum, Deposit. Quarry 4½ miles south of Deposit near Pennsylvania state line. The bed of stone exposed is 13 feet thick, with top 12 to 35 feet thick of rock, shale and earth. The bed is horizontal. The lifts vary from 1½" to 8". The grain of the stone varies from the top down. The stone from

the upper lifts is coarse grained, while in the lower lifts the stone is finer grained and reedy. The color is fairly good blue throughout. The side seams are fairly regular, but as usual the heads are rough and uneven. The product includes flag and edge stone, which is sold to Travis & Kingsbury at Hale Eddy. Four men are employed.

Kinney & Lee, Hale Eddy. This quarry is just above Link-room's and is a new opening. 12 feet of bed are workable, above which are 8 feet of rock and 6 feet of dirt. The lifts are nearly all thin, 1" to 2", and the product is chiefly flag. The stone is rather fine grained and when not discolored by sap is of good blue color. The bed is horizontal and is divided by vertical joints of the usual direction. The east and west joints are very irregular. Travis & Kingsbury at Hale Eddy buy the stone. The cost of cartage is 10% of the value of the load. Four men are employed.

Curtis & Smith, Sherman Pa. Quarry lies just north of Pennsylvania line, 5 miles south of Deposit. The bed of stone is 5 feet thick, with 15 to 30 feet of shale top. The stone is fine grained and compact. It is of gray blue color, except where discolored by sap. The bed is horizontal, and the seams 3" to 8" apart. The face of the quarry is east and west, 200 feet long. Both systems of vertical jointing are present. The product is chiefly flag and edge stone, which is sold at Hale Eddy to Travis & Kingsbury. Three men are employed.

Hobbs & Tupper, Hale Eddy. These men work on same ledge as Curtis & Smith. Two men are employed. Both quarries are in Broome county.

John F. Sprague, Oquaga Lake. Quarry is $1\frac{1}{2}$ miles southeast of Oquaga Lake. The quarry has been open for a number of years and was worked extensively for a time. The scale of operations is now small, and the main ledge is not worked. Some outside blocks are being worked into flag. The bed of stone in main ledge is 8 feet thick, with 12 to 20 feet of rock top. The stone is uniformly coarse grained and gray. The vertical joints are well developed and straight. The lifts run quite

heavy in the main ledge, 6" to 10". The stone is free from reeds. The bed is horizontal. The outside blocks are thin bedded and produce flag 1" to 2" thick, which is as smooth as a board. It is the intention of the owner to put in a derrick, strip the main ledge, and quarry stone on a somewhat larger scale. The product is sold at Hale Eddy and Deposit.

Andrew Weyman, Deposit. Quarry 1 mile south of Oquaga Lake. The quarry is very small. The bed of stone is 5 feet thick, with 8 feet of shaly top. The stone is thin bedded, gray and coarse grained. The product, which is flag, is hauled to Hale Eddy. It is worked only intermittently.

Riley Shellman, Deposit. Quarry is situated on Sand pond hill, 2½ miles south of Deposit, in Broome county. The bed of stone is 4½ feet thick, with 15 feet of rock top, which is broken. The bed dips to the west slightly and is divided by regular vertical joints north and south. The east and west joints are uneven and rough. The stone is fine grained, compact and gray blue. Near the joints the stone is discolored by sap. The lifts vary from 1½" to 4" in thickness. Few reeds are present. The ledge has been opened 250 feet along the side seams. The product of flag and curb is sold at Deposit to Deposit stone co. Three men are employed.

P. J. Madden, Deposit. Quarry is situated in Broome county south of McClure postoffice on hill south of Erie railroad. This is quite an extensive quarry, and is worked on a larger scale than usual in the district. The bed of stone is 12 feet thick and has an overburden of red shale 25 feet thick. The red shale is not often found in this vicinity. Just below the shale and above the bed is a stratum of rock 4 feet thick, which has a greenish tinge. The north and south vertical joints, or side seams, are regular and smooth, but the other system of vertical jointing is very irregular. The ledge has been opened around the hill 150 feet. The lifts vary from 6" to 20" in thickness, but are reedy and can be split into 2" flag if necessary. The stone is fine grained, compact and a light gray blue. The quarry is favorably situated near the Sand bank switch on the Erie,



H. T. Dickinson, photo.
Bluestone quarry of Conrow and Hauck, north of Deposit, showing
"black jack"

where Mr Madden has a loading dock. The product includes all varieties of stone. Six to 10 men are employed the year round. The quarry is equipped with a hand power derrick.

Patrick McAvoy, Deposit. Quarry situated on Shaeffer hill $2\frac{1}{2}$ miles north of Deposit. The quarry is very small, showing 4 feet of thin bedded, coarse grained stone. The bed dips to the northeast rather sharply and is covered with a top of thin bedded rock 12 to 15 feet thick. The vertical jointing is very irregular. The product is chiefly flag, which is sold at Deposit to Kirkpatrick Bros.

John W. Scott, Deposit. Quarry $2\frac{1}{2}$ miles northeast of Deposit on Rooney hill. The bed is horizontal and 9 feet thick at the maximum. The top is of red rock 10 to 15 feet thick, some of which is worked into salable stone. The seams are 6" to 8" apart. The face of the quarry runs 125 feet north and south. The stone is fine grained, light gray blue and very dense. The product is chiefly edge stone, which is sold to Kirkpatrick Bros. at Deposit. Two men are employed.

Conrow & Haneyk, Deposit. This firm is quarrying on the northern end of the ledge where Scott is quarrying. Here black jack occurs, which has eaten the bed down to $4\frac{1}{2}$ feet. The black jack is lens-shaped, soft and crumbles in the hand. Two men are employed.

F. D. Walley, Deposit. Quarry is 2 miles north of Deposit on west side of Delaware river. The bed of stone is 10 feet thick, with a 2 foot streak of rough rock 3 feet below the top of bed. The stone below the rough streak is of better quality than above it. The bed pitches to the south and west gently. The striping consists of 5 feet of rock and 13 feet of earth containing boulders. The stone is fine grained and gray blue. The side seams are regular, but the headers are very rough. The lifts vary from 2" to 8". The product is sold to Kirkpatrick Bros. at Deposit. Two men are employed.

George Shellman, Deposit. Quarry $5\frac{1}{2}$ miles from Deposit on west side of Delaware river. The bed of stone is $6\frac{1}{2}$ feet thick, with a top (varying from 7 to 15 feet in thickness) mostly of rock.

The stone is of medium grain and blue when not discolored by sap. The lifts are evenly bedded and range from 3" to 6" in thickness. The bed is horizontal. The side seams are regular and smooth, but no heads are to be seen. The stone is sold to Kirkpatrick Bros. at Deposit. Two to three men are employed.

Shellman & Warner, Deposit. This firm is just opening a quarry north of Walley's quarry. Three to four men are employed.

Near Hale Eddy the following quarries are in active operation.

Ostram & Freeman, Hale Eddy. Quarry is situated 1 mile north of Hale Eddy. The bed of stone is $6\frac{1}{2}$ feet thick, with 12 feet of top, 4 feet of which are earth and the balance rock. The stone is badly stained with sap and has only occasional streaks of blue. It is fine grained and dense. The top rock is very hard and can be drilled only with difficulty. The seams are irregular, having a tendency to shift and grow, causing a large amount of waste. 10% of the value of each load is paid for cartage to Hale Eddy, where the stone is sold to Travis & Kingsbury.

G. N. Lord, Hale Eddy. Quarry is in Broome county, $\frac{3}{4}$ of a mile east of Hale Eddy on south side of Delaware river. The bed of stone is 7 feet thick, with 11 to 13 feet of rock top and 4 feet of earth. The stone is fine grained and of a good blue. Near the joints it is stained with sap. The bed dips to the south-east. The side seams are quite regular and smooth. The lifts vary from 3" to 6". The product is chiefly flag and edge stone, which is sold at Hale Eddy to Travis & Kingsbury. One man is employed.

Jones & Adams, Hale Eddy. This quarry is $\frac{1}{4}$ of a mile east of Lord's and in the same range. The bed of stone is 7 feet thick, covered with 12 to 25 feet of rock and earth. The face of quarry extends east and west 150 feet. The north and south joints are straight and even, while the east and west joints are very irregular. The bed is horizontal, with seams 2" to 6" apart. The seams are quite apt to shift and grow. The stone is sold at Hale Eddy to Travis & Kingsbury. Three men are employed.

On both sides of Rood and Sands creeks, which flow southward into the Delaware, quarries have been opened. Those in active operation follow.

Arthur Beagle, Hale Eddy. Quarry on western side of the west branch of Rood creek, 2 miles from Erie railroad. The ledge has been opened up 500 feet long in a north and south direction. At its maximum height the face is 50 feet, of which 16 feet are stone, the balance being rock (in which some shale occurs) and earth. The bed dips slightly to the south and west. The side seams and heads are quite regular, the average area of a block being 2000 square feet. The bed of stone has been shown to be 25 feet thick, but, owing to the tightness of the lifts at the bottom, the stone can not be quarried. The stone is rather coarse grained, of fairly good blue color (specially the lower lifts) and reedy. It is maintained that these reeds will not open. The lifts vary in thickness from 2" to 6". The product consists of flag and edge stone, which is sold to Travis & Kingsbury. Three men are employed.

Beagle & Mayo, Hale Eddy. This firm is quarrying on the same ledge as Arthur Beagle. Its product is sold to Kirkpatrick Bros. at Rood creek switch on the Erie railroad. A hand power derrick is in use. Three men are employed.

Patrick Griffen, Hale Eddy. Quarry is on west side of eastern branch of Rood creek. The ledge is covered with 2 feet of earth; then come in succession 4 feet of rock, 6 feet of stone, 4 feet of shale and rough stone, and at the bottom $2\frac{1}{2}$ feet of stone. The bed dips to the south and east. The two systems of vertical jointing are present. The stone is coarse grained and has a greenish blue appearance. The product of flag is sold to Travis & Kingsbury at Rood creek switch. Two to three men are employed.

Van Aken & Minko, Hale Eddy. Two men are employed in quarrying on same ledge as Griffen.

Richard Kennedy, Hancock. Quarry situated on eastern side of Rood creek $2\frac{1}{2}$ miles north of Erie railroad. The bed of stone here is 9 feet thick, with top ranging from 10 to 25 feet of rock.

The stone is coarse grained and greenish gray blue in color. The face of the quarry is 450 feet long in an east and west direction. The bed was 15 feet thick in the early history of the quarry, but "the bottom has pitched up and pinched it out." The vertical joints are irregular, as is the dip. The product is hauled 3 miles to Hale Eddy at a cost of 20% of the value of the load. It is sold to both local dealers. Two men are employed.

Shaefer Bros., Hancock. This quarry, on eastern side of Rood creek and 3 miles from Erie railroad, is said to be one of the best quarries in this vicinity. The quarry face is 800 feet long in an east and west direction. The dip of the strata is to the east, where the water collects and is drained by a ditch. The bed of stone averages 14 feet in thickness. Overlying it are 3 feet of rock and 10 to 20 feet of earth. The vertical jointing is not uniform, but has the usual direction. The lifts vary from 4" to 44" in thickness. The stone is medium fine grain and of fair blue gray color. The product is chiefly rock, but some edge stone is cut. The quarry is equipped with hand power derrick. Six men are employed during the year.

Thomas Roche, Hancock. Two men are employed quarrying on Shaefer's ledge west of the opening. The stone is all hauled to Rood creek switch on the Erie railroad and sold to both local dealers.

Elmer Beagle, Hancock. Quarry on west side of Rood creek, $3\frac{1}{2}$ miles from Erie railroad. This quarry face shows but $4\frac{1}{2}$ feet of bed, with 20 to 25 feet of interbedded rock and shale. The stone is coarse grained. The top lifts are gray and the bottom are gray blue. Black jack occurs here and has eaten out 3 feet of the bed, which was 8 feet thick when the quarry was first opened. The vertical seams are irregular. The bed dips slightly to the west. The product is chiefly flag, which is sold at Rood creek switch to Travis & Kingsbury. The cost of cartage is 20% of the value of the load of stone. Two men are employed.

Bert Lee, Hancock. Quarry is situated on the hill on the west side of Rood creek and on the north side of the Delaware river.

The opening is not large, showing 6 feet of bed with 12 to 15 feet of rock top. The stone is thin bedded, medium coarse grained and grayish blue in color. The vertical joints are irregular in direction. The seams are $1\frac{1}{2}$ " to 4" apart, and some are rough. The bed has a slight pitch to the west. The product of flag is sold to Kirkpatrick Bros. at Rood creek switch. Two men are employed.

Travis & Kingsbury, Hancock. This is a firm of buyers and quarrymen. The quarry is on north side of Delaware river, $4\frac{1}{2}$ miles northwest of Hancock. The opening is an old one and is 1200 feet long in an east and west direction. The western end only is being worked. There are two beds of workable stone. The top bed, 7 feet thick, is separated from the lower bed, 5 feet thick, by a rough streak 5 feet thick. Above the top bed there are 25 feet of rock and 1 to 2 feet of clay. The beds pitch rather more sharply than usual to the north. The stone is coarse grained and ranges in color from light blue to greenish gray. The vertical joints are quite irregular in direction. The beds at the eastern end of the opening are horizontal, which shows the variation of the dip. This is a common feature of the quarries of this district. The stone is carted to Travis & Kingsbury's yards at Rood creek switch. Seven to eight men are employed.

Robert Moore, Hancock. Quarry $5\frac{1}{2}$ miles north of Hancock on west side of Sands creek hollow. The face of the ledge has been opened 300 feet east and west, and shows bed of 12 feet of stone covered with 8 to 15 feet of rock top. The seams are even and 1" to 6" apart. The stone is rather coarse grained and of good blue color when sap has not discolored it. The bed is horizontal. The stone is worked into flag chiefly, which is sold to Randall Bros. at Hancock. Four men are employed.

Crozier & Bahan, Hancock. This firm is opening a quarry on the Moore ledge. Two men are employed.

Fitch & Randall, Hancock. Quarry 5 miles northwest of Hancock on west side of Sands creek. The bed of stone is 7 feet thick, with 5 to 6 feet of rock and earth top. The quarry was opened this season. The stone is coarse grained and greenish

blue. The lifts vary from $1\frac{1}{2}$ " to 4". Randall Bros. at Hancock handle all the product, which is chiefly flag. Four men are employed.

Rice & Co., Hancock. Quarry is 3 miles northwest of Hancock on western side of Sands creek near the top of the hill. The ledge has been opened 300 feet north and south along the side seams. The stripping, amounting to 30 feet of rock covered with a layer of earth, covers a bed of stone 15 feet thick, with lifts varying from 6" to 24". The stone is coarse grained and gray blue. Sap has discolored the bed near the joints. Reeds are present and are of the type which tighten on exposure. The product is principally curb and rock, which is sold to Kirkpatrick Bros. at Sands switch on the Erie railroad. Three men are employed.

M. J. Ford, Hancock. Quarry is situated on west side of Sands creek $2\frac{1}{2}$ miles northwest of Hancock. The bed of stone is 8 to 9 feet thick with 22 to 25 feet of rock, shale and earth top. The stone is coarse grained and the lower lifts are of fairly good blue color. The upper lifts are greenish gray. Some cross bedding appears in the ledge, causing waste. The vertical joints are irregular and stained with iron. The lifts vary from $1\frac{1}{4}$ " to 5". The product includes all varieties of stone, which is sold to Randall Bros. at Hancock. Three men are employed. Cost of cartage to Hancock is 17% per value of load.

Patrick White, Hancock. Quarry is situated on the same hill as Ford's, but several ledges above. The bed of stone is 10 to 11 feet thick, with 20 feet of rock top. The bed dips somewhat more sharply than usual to the west. The bed is divided by joints, which are not exactly vertical, dipping slightly to the east. The stone is even bedded, the lifts varying from 2" to 9" in thickness. The stone is coarse grained and greenish gray blue. The product includes flag and edge stone, which is sold to G. W. Kazenstein, a small buyer at Hancock on the Scranton branch of the Ontario and Western railroad. Two men are employed.

Edward Kearney, Hancock. This quarry is just opened on a ledge above Ford's and below White's. The bed of stone worked





H. T. Dickinson, photo.

Bluestone quarry in Sands creek hollow near Hancock N. Y.

so far is 4 feet thick and covered with a rock top of 10 to 15 feet. The stone is coarse grained and light gray blue. The lifts vary from 1" to 3". The stone is sold to Randall Bros. at Hancock. Two men are employed six months in the year.

Johnson & Dirig, Hancock. Quarry is 3 miles northwest of Hancock on east side of Sands creek. The ledge has been opened 700 feet around the edge of the hill. The quarry has been worked extensively and is now producing a medium amount of stone. The face has a maximum height of 52 feet, 40 feet of which are pencil and 12 feet bed. The upper 3 feet of bed are thin bedded and suitable for flagging; but the lower lifts are very heavy, with few reeds which are hard to split, the seams being 2 to 3½ feet apart. These heavy lifts are sold as rock to Kirkpatrick Bros. at Sands switch. The bed dips slightly to the south. The system of jointing is regular and smooth. 20% of the value of each load is paid for cartage. Two to four men are employed, eight months in the year.

Arnold Grimsback, Hancock. This quarry is on west side of Bear brook hollow 1 mile northwest of Hancock. This quarry, known as the Baily quarry, was at one time a great producer of stone, but is now worked at one end only. The face is 450 feet long, north and south, and shows a bed of stone ranging from 5 to 15 feet in thickness. The top is very heavy, 10 to 40 feet thick and of rock. The stone is coarse grained and of good gray blue. The lifts vary from 3 inches to 4 feet in thickness. The stone is worked into edge stone and rock. Little flag is produced, on account of the heavy lifts. The product is sold to Randolph Bros. at Hancock. One man is employed.

Hanrahan & Cahill, Hancock. This quarry is 2 miles northwest of Hancock in Bear brook hollow. The bed of stone is 8 feet thick, with 7 feet of clay and shale top. The stone is even bedded (the seam being 1½" to 6" apart) of medium fine grain and a dirty blue color. The product is flag and edge stone, which is sold to Kirkpatrick Bros. at Hancock. The cost of cartage is 17% of the value of each load. Two men are employed. The quarry has been opened 10 months.

P. Hanrahan, Hancock. A very small quarry situated on Coon hill 3 miles north of Hancock. The bed of stone is 4 feet thick, with 8 to 10 feet of rock and shale top. The bed is quite rough, dipping gently to the northeast. The stone is of medium grain and grayish blue, lifts varying from 2" to 3". The product is chiefly flag, sold to Kirkpatrick Bros. at Hancock. Two men employed.

Thomas Scully, Hancock. The quarry is situated on the point of the hill $\frac{1}{2}$ mile north of Hancock. The bed is horizontal and 10 to 14 feet thick. It is covered with a top of rock 25 to 30 feet thick. The stone is of medium grain and gray blue in color. Reeds occur in the lifts, which split easily. A rough streak appears in some parts of the bed and causes waste. The two systems of vertical jointing are as usual in the district. The north and south joints are the more regular. The lifts vary in thickness from 3" to 12". It is said that quarrying can be carried on all the year without affecting the stability of the stone. The face of the quarry is 250 feet long. The product consisting of rock, edge stone, and some flag, is bought by Kirkpatrick Bros. at Hancock. The quarry is equipped with hand power derrick. Four men are employed.

O'Rourke & Stewart. Quarry is situated near Women pond 6 miles east of Hancock. The bed averages 6 feet in thickness and is covered by thin bedded rock 12 to 15 feet thick. The bed dips to the southwest at a noticeable angle. Cross bedding appears in the top. The stone is coarse grained and a bluish gray, and flag is the chief product. The vertical jointing is irregular. The product is chiefly flag, which is carted to Stockport and sold to Kirkpatrick Bros. Two to three men are employed.

Comfort & Wood, Hancock. Quarry is 1 mile west of O'Rourke & Stewart's. The bed of stone is 6 feet thick and covered with 12 to 14 feet of rock and clay. The opening is not large. The north and south vertical joints are well developed and regular, but the east and west joints are not uniform. The stone is coarse grained and gray blue. The product is sold to Kirkpatrick Bros. at Stockport.

Between Stockport and Lordville there are three quarries in operation: two of Henry Prigge's and one of John Cuddike's. The product from these quarries is shipped by the Erie railroad at Kilgore's switch. One of Prigge's quarries is situated on hillside north of Delaware river and $\frac{1}{2}$ mile northeast of Kilgore's switch. The thickness of the workable bed averages 6 feet and is of even, thin bedded, grayish, fine grained stone, which is reedy. The stripping consists of 2 feet of rock and 10 to 35 feet of earth containing boulders. The bed dips slightly to the northwest. The vertical joints are irregular and curved. The lifts vary in thickness from 2" to 4". The product is chiefly flag. Three to four men are employed.

The other quarry of Prigge's is on the same hill as the above, but on the western side. The bed of stone dips to the west and is 10 feet thick. There is a rough streak 3 feet thick in the middle of the bed, all of which is waste. The top is 40 to 45 feet thick, 10 feet of which are red clay, the balance being thin, irregular bedded rock. The stone is fine grained, gray blue and reedy. It is said that these reeds will not open by weathering. Four to five men are employed.

John Cuddike, Lordville. Quarry situated 1 mile north of Kilgore's switch on west side of hollow. The opening is small, but interesting on account of the lens of black jack which occurs in the top, which is of shale and rock and 16 feet thick. The stone is of medium grain and is gray blue. The even bedded lifts are 4" to 8" thick. The thickness of the workable stone is $4\frac{1}{2}$ feet. Two men are employed.

List of docks and stone buyers along Erie and Ontario and Western railroads

Kirkpatrick Bros. Hancock

Erie. Deposit: 125 cars a year (estimated), three men employed.

Rood creek switch: 150 cars a year, three men employed.

Hancock: 200 cars a year, four to five men employed.

Stockport: 40 to 50 (20 ton) cars a year.

Lordville: 300 (20 ton) cars in 1899, four employees.

O. & W. Tyler's switch: 40 to 50 cars a year.

Travis & Kingsbury, Hale Eddy

Erie. Hale Eddy: 250 cars a year, two to three men, hand derrick.

Rood creek switch: 450 (20 ton) cars a year, two to four men employed, hand derrick.

Randall Bros. Hancock

O. & W. Tunnel switch: 50 cars a year.

Erie. Hancock: 250 cars a year, two men employed.

Deposit stone co. Deposit

Erie. Deposit: 200 (20 ton) cars a year, two men employed loading.

Sand bank switch: 25 cars a year, two men employed loading.

Sands creek switch: 125 (20 ton) cars a year, three men employed.

P. J. Madden, Deposit

Erie. Sand bank switch: 150 to 200 cars a year.

Henry Prigge, Lordville

Erie. Kilgore's switch: 40 to 50 cars a year, two men employed.

Standard bluestone co. Jersey City

Erie. Lordville: 196 (20 ton) cars a year, two yardmen.

G.W. Kazenstein, Hancock

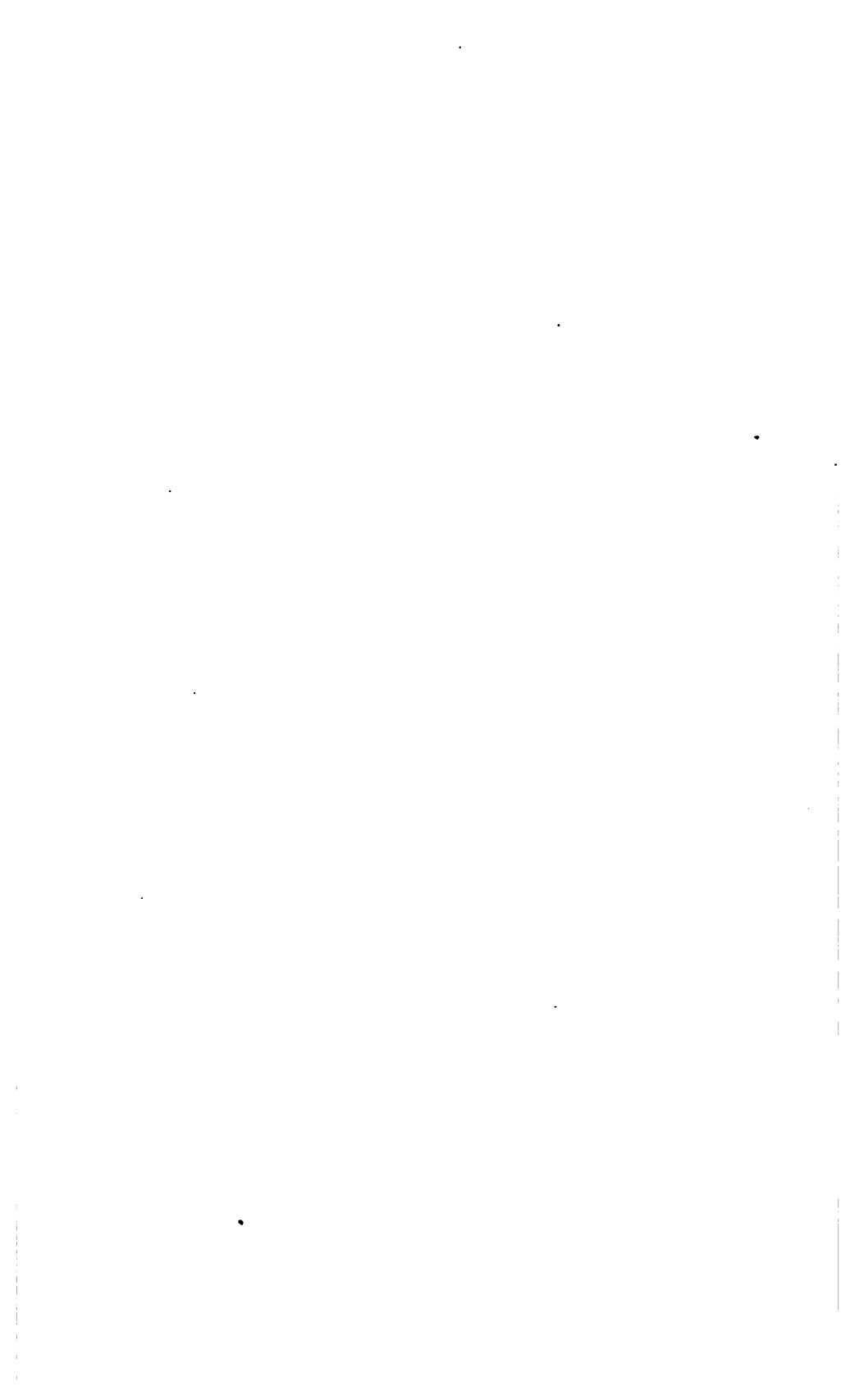
O. & W. Hancock: 125 cars a year.

Average value of carload of stone of 20 tons is \$90.

During 1900 the cost of freight from above docks to markets in Jersey City was \$1.55 a ton, in New York \$2.15 a ton and in Philadelphia \$2 a ton.

QUARRIES IN THE SOUTHCENTRAL COUNTIES**Oneonta, Otsego co.**

Bluestone quarry of Olds & Miller, situated north of West Davenport, 5 miles east of Oneonta. A very fine quality of hand dressed stone is produced. The stone is of good blue color and fine grained, and takes tooling nicely. The bed of stone is 8 feet thick with 8 to 9 feet of stripping of rock and clay. The lifts vary from 4" to 8" and are smooth. The product includes flag and all varieties of edge stone. The market





Quarry of F. G. Clarke bluestone co. Oxford N. Y.

is chiefly in Oneonta and other towns along the Delaware & Hudson railroad.

Several other small quarries have been opened near Oneonta for common building stone, but are worked only at irregular intervals.

Oxford, Chenango co.

The largest quarry of bluestone in New York is situated northwest of Oxford on the west side of the Chenango valley, 150 feet above the railroad. The quarry was first opened in 1874 and operated in a small way till 1880, when F. G. Clarke (later F. G. Clarke & Son and F. G. Clarke bluestone co.) took hold and began quarrying on a large scale. The bed of stone has a total thickness of 18 feet, and the stripping, or overburden, consists of 40 feet of drift earth, in which are imbedded large boulders and 25 feet of solid rock. The top 10 feet of bed is divided by horizontal seams 4" and upward apart. The stone from this bed is used chiefly for platforms. The bottom 8 feet is of two lifts 4 feet thick, and known as "liver" rock. Liver rock is very dark blue and can be worked equally well in all directions; and is used chiefly for house trimmings and building stone. The stone is a good blue, fine grained and softer than the Ulster county stone. The following tests and analyses are interesting.

Stone from the quarries of the F. G. Clarke bluestone co.

TESTS MADE AT THE NEW YORK STATE MUSEUM, UNDER THE
DIRECTION OF PROF. J. C. SMOCK

Specific gravity	2.7113
Weight, per cubic foot	168.97
Percentage of water absorbed	1.11
Weight of water per cubic foot	1.876
Percentage of gain in weight in CO ₂ gas	.0024
Weight increased in lb (per cubic ft)	.0041
Percentage of gain in sulfurous acid	.064
Weight increased per cubic ft	.108
Freezing and thawing test	No effect

CRUSHING TEST MADE UNDER THE SUPERVISION OF THE ASSISTANT
ENGINEER EMPLOYED IN TESTING MATERIAL FOR THE PEDESTAL
OF THE STATUE OF "LIBERTY ENLIGHTENING THE WORLD,"
AP. 20, 1884

Dimensions

1st cube, 3 in. x 2.936 in. x 2.786 in. = 8.18 sq. in.

2d " 3 in. x 2.77 in. x 2.776 in. = 7.699 "

3d " 3 in. x 2.888 in. x 2.802 in. = 8.092 "

No. 1 bore a strain of 103,700 lb before crushing on its quarry
bed

No. 2 bore a strain of 103,600 lb before crushing on its quarry
bed

No. 3 bore a strain of 98,340 lb before crushing not on its quarry
bed

The 1st stood a strain of 12,677 lb to the sq. in.

" 2d " 13,472 "

" 3d " 12,152.7 "

ANALYSIS MADE BY W. E. GIFFORD, CHEMIST, 54 PINE ST. NEW YORK

Silica	77.56
Alumina	10.65
Oxid of iron	4.59
Oxid of manganese	.09
Lime	.34
Magnesia	1.22
Potassa	2.15
Soda	.9
Water	1.93
Undetermined matter and loss	.57

100

The strata are horizontal and the situation of the quarry is such that the drainage is natural. The quarry face is 1000 feet long in a north and south direction and is being worked at various points. The stripping is carried on during the winter season and is done by blasting. The earth is carted away by wagon, and the rock is piled up east of the face by the derrick.

A wire tramway was in use for stripping, but has been found to be of little advantage. The bed of stone is blasted out, holes being bored by steam drills and reamed out according to the Knox system. A channeling machine was formerly used. The quarry is equipped with three steam power derricks. A mill equipped with planers, gang saws and rubbing bed is run in connection with the quarry. Here the stone is prepared for the various demands of the market. 100 men are employed in quarrying and dressing the stone. 1000 carloads have been shipped this year by the Ontario and Western railroad to various points. The market is chiefly in New York and Pennsylvania towns. A special car capable of carrying a stone 25 feet x 15 feet is used by the company in shipping the largest stone.

Examples of construction in which the Oxford bluestone has been used are, the lower portions of Aldrich court, 41-43 Broadway, New York; the steps in the terrace approaching the capitol at Washington; the steps, platforms and column bases of the capitol at Trenton N. J.; St Lawrence hall, New Haven Ct.; the state prison for insane criminals at Matteawan N. Y.; the Oxford bank building at Oxford; and the Trinity Memorial church at Binghamton N. Y.

South Oxford, Chenango co.

F. G. Clarke bluestone co. operates a quarry 1 mile east of the railroad. The face is 600 feet long in a north and south direction. A top bed of 4 feet is quarried mainly for flagging. It is covered with a top of 4 feet of clay. Underneath the bed of flag is shale 15 feet thick, covering the liver rock 9 feet thick. The same system of quarrying is in use as at Oxford. The quarry is equipped with hand derricks and drills. The flag is shipped from Coventry Station by the railroad, but the liver rock is sent to Oxford for mill treatment. 50 men are employed throughout the year.

Several small quarries have been opened in the vicinity of South Oxford for flagging at Tyner, Walker's Corners and Springfield Flats.

King's Ferry, Cayuga co.

Quarry of Cusick & Murray is $\frac{1}{2}$ mile south of King's Ferry. This quarry has been opened 10 years, and produces flagging, curb and cross walks for the towns of Elmira, Waverly, Auburn, Ithaca, and others in New York state. The stone is dark blue, fine grained and easily split to a thickness of 2". Very little dressing is done except for the curb and cross walks. The product is hauled to King's Ferry station and shipped by the Lehigh Valley railroad. The face of the quarry is 800 feet long in a northwest and southeast direction. The bed of stone is 22" thick and divided by two systems of vertical jointing running northeast and southwest, and northwest and southeast. The vertical joints are from 2 to 60 feet apart. The bed is covered with 14 feet of dirt and 6 feet of shale. Stripping is done by blasting and handled by carts and wagons. In the shale top at the southern end of the quarry a 5" stratum of stone occurs 14" above the top of the main bed. The equipment of quarry includes two derricks (one hand power, one steam power) and a blacksmith shop. 20 men are employed the year round. The output averages 200 cars a year.

The prices obtained f. o. b. King's Ferry are, 9c to 15c a square foot for flag according to size and thickness; 25c to 30c a linear foot for 20" curb; rock, 3c to 4c an inch per square foot.

Goodyears, Cayuga co.

J. G. Barger quarries flagging and building stone on a small scale here. The quarry was worked very little during the summer of 1900.

Trumansburg, Tompkins co.

Cusick & Murray are operating a quarry near Halseyville 2 miles west of Trumansburg on south side of Taughannock creek. The product is chiefly flagging, and is sold at the same points as the stone from the King's Ferry quarry. Three beds are being worked, separated by beds of shale. 15 to 18 feet of soil and 4 feet of shale cover the top bed, which is 4 feet thick. Between the top and middle bed which is 2 feet thick are 6 feet of shale. Then come 4 feet more of shale and a bed of stone 2 feet thick.



H. T. Dickinson, photo.

Bluestone quarry of J. T. Hunt, 6 miles north of Trumansburg N. Y., 1 mile west of Lake Cayuga

The face of the quarry runs north and south, and is 500 feet long. The jointing is north and south. Drainage is natural. The stone is a very dark blue, fine grained and easily split. A hand power derrick and steam drill are part of the equipment. Five to six men are employed during the year. The stone is shipped from Taughannock Falls station on the Lehigh Valley railroad.

On both sides of Taughannock creek, just below the falls, flagstone is being quarried by two operators, F. C. Biggs employing two to three men, and Peter O'Hara employing six to seven men. The bed worked is 3 to 4 feet thick and covered with 6 to 10 feet of soil. The stone is dark blue, fine grained and reedy. The lifts vary from 6 inches to 1 foot, but can be split easily to 2". Drilling is done by "jumper" drills, otherwise the quarrying is the same as in Ulster county. The product is shipped at Taughannock Falls by the Lehigh Valley railroad to Syracuse, Rochester, Ithaca and Sayre Pa. Each operator has a hand derrick.

Several quarries $\frac{3}{4}$ of a mile west of the shore of Cayuga lake have been opened, but have not been worked in late years.

J. T. Hunt of Farmer operates a small quarry 6 miles from Trumansburg and 1 mile west of Cayuga lake. The product is flag of a reddish tinge and is quarried for local uses.

Ithaca, Tompkins co.

Sandstone of the Portage horizon is quarried $1\frac{1}{2}$ miles south of Ithaca on the hillside above and below the Delaware, Lackawanna and Western railroad track. The stone is used for flagging, common building stone, and is crushed for road metal. The stone is a dark bluish gray and fine grained. The beds vary from 10 to 16 feet in thickness and have occasional streaks of shale in them. The stripping of earth is 6 to 20 feet thick. The stone is thin bedded, the distance between the seams averaging 2". The two quarries produce road metal and are equipped with steam crushers and drills.

Wilbur J. Bates operates a quarry on the hill in the southern part of the town intermittently. The bed is 35 feet thick, a great deal of which is waste. The lifts vary from 2" to 10" in thick-

ness, and in the lower part of the bed are very uneven. The stone is very dark with a slight reddish tinge, and fine grained. The vertical joints dip slightly to the east and run north and south. The dip of the bed is at a gentle angle to the south. The product is used for road metal and foundations. Some trimmings are cut, such as sills and lintels. The quarry is equipped with a crusher.

"Sandstone" for the Cornell university buildings was quarried on the site of Cascadilla hall and at a quarry in front of the main building, but lower on the hillside. Another quarry was opened near the McGraw-Fiske mansion and Fall creek. The stone in Cascadilla hall is the best from these local quarries.

A quarry on E. State street is operated by Driscoll Bros. (contractors). Stone is quarried as needed. The bed of stone is 22 feet thick, with 18 to 20 feet of top. The vertical joints run east and west, and are smooth and regular, 6 to 10 feet apart. Lifts vary from 2" to 4". The stone is fine grained, dark colored and of red and green tinges. The product is used locally for trimmings and foundation work.

Penn Yan, Yates co.

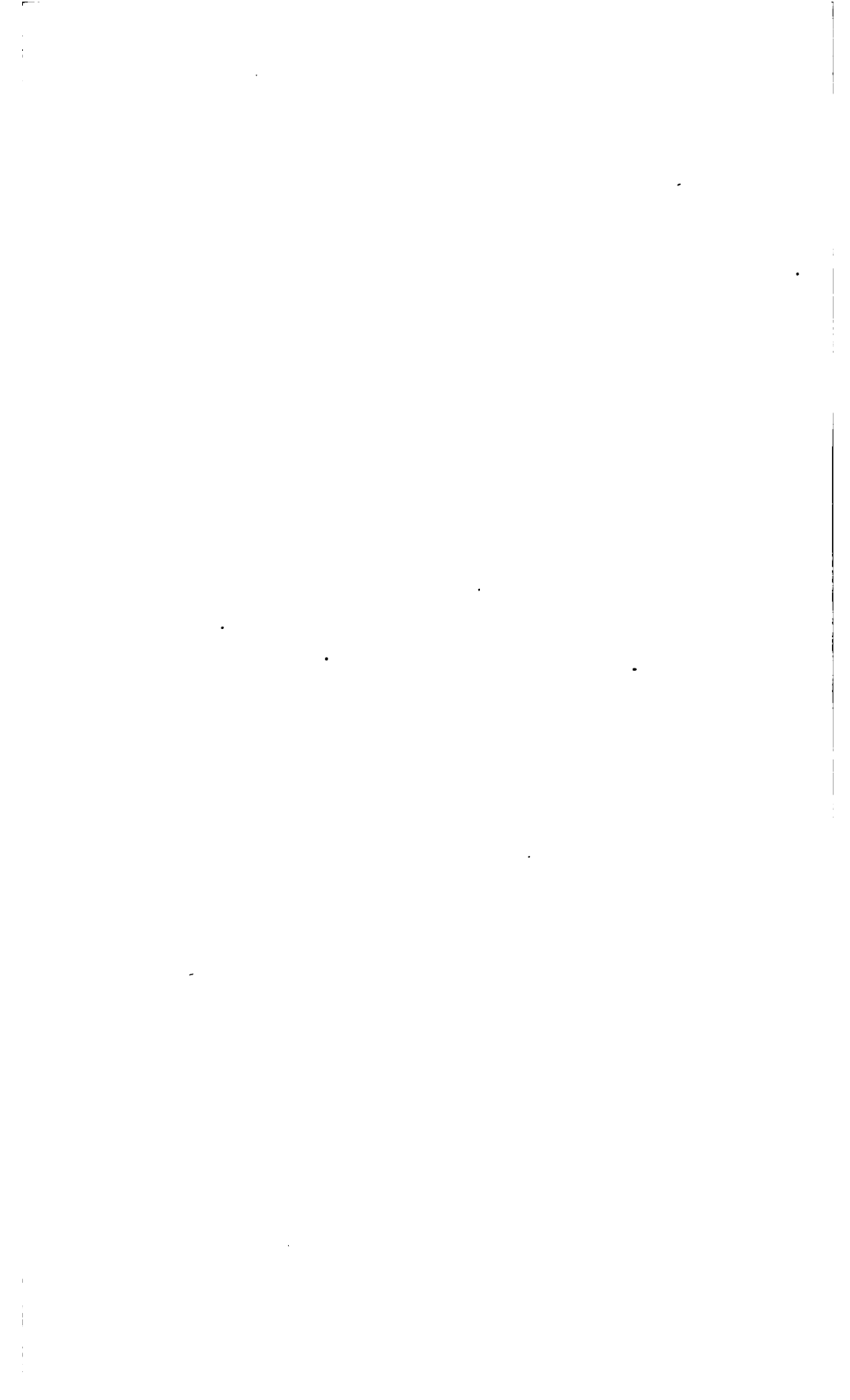
3 miles south of Penn Yan and $\frac{1}{2}$ mile east of Keuka lake a quarry has been opened by S. Thayer. The quarry is very small, and the product is rough foundation stone, which is used locally. The stone is very coarse grained and shaly. The vertical joints are very irregular. 10 feet of rock cover the 4 feet of bed of stone.

F. E. Hoyt and Warren Sanford have opened quarries south of Penn Yan, but they have not been worked for several years.

James Woodruff's quarry is $3\frac{1}{2}$ miles south of Penn Yan and $1\frac{1}{2}$ miles east of Keuka lake. The bed of workable stone is 2 feet thick with 5 feet of shale and earth top. The stone is fine grained, dark blue, and compact. The bed is horizontal. The product is rough building stone, which is used in Penn Yan for foundations.

Himrod, Yates co.

Evan Potter's quarry is situated $1\frac{1}{2}$ miles east of Himrod. The stone is fine grained and very dark blue. The bed is 2 feet





H. T. Dickinson, photo.

Bluestone quarry of Genesee Valley bluestone co., 3 miles south of Portageville N. Y. on
Pennsylvania R. R.

thick with 3 feet of shale and earth overburden. The product is all rough building stone, some of which is used for culverts on the roads. Louis Cheney has also worked a small quarry near Himrod, but not for some time.

Watkins, Schuyler co.

No quarries are worked continuously here, but there is an opening in the hill $1\frac{1}{2}$ miles south of Watkins, made by the Elmira and Watkins electric road, that is worked intermittently. The face at the back is 50 feet high and 200 feet long. Stone and shale are interbedded, the thickness of the stone approximating 12 feet. The stone is fine grained, even bedded and very dark blue. It is not handsome, but durable. The stone has been used for culverts on the electric railroad between Watkins and Elmira.

Portage, Livingston co.

The quarry of the Genesee Valley bluestone co. is 3 miles south of Portageville, just west of the Western New York and Pennsylvania railroad in Wyoming county. It has been worked for many years, and a large amount of stone has been produced.

The excavation is rectangular in shape, 120 feet x 210 feet. The stripping is of clay 20 to 40 feet thick, and increases on the western side. A great deal of trouble is experienced with the top, as part of it is in the nature of quicksand, and slides occur during the wet season, filling the opening with earth, sand and rock. The bed has been worked to a depth of 42 feet, divided into lifts by mud seams 2 to 8 feet apart. The lifts run in the following thicknesses vertically: 8 feet, 2 feet, $1\frac{1}{2}$ feet, 3 feet, $2\frac{1}{2}$ feet, $1\frac{3}{4}$ feet, $1\frac{3}{4}$ feet, 8 feet and 14 feet. The second lift from the bottom, 8 feet thick, contains a streak of stone containing a large amount of iron and is known as "black rock." This is of poor color and is sawed into flag. Just above the black rock the best stone is produced. The stone is fine grained and soft. The best is greenish blue. It is homogeneous in texture, easily worked and presents a very fine finish.

A representative specimen of this stone gave the following tests: Specific gravity 2.695, weight per cubic foot 168 lb, water absorbed 2.97%.

The loss by treatment with dilute H_2SO_4 was .42%. Freezing and thawing tests produced but slight scaling. At a temperature of 1200° to 1400° F the color changed to a dull red. There were no checks, and the strength of the specimen was but little impaired. It is said to harden on exposure, and if quarried during cold weather will check badly from frost. Owing to the depth of the pit below the surrounding country, water is troublesome. It is removed by means of a steam pump. The quarry is also equipped with Wardwell channeling machine, Rand drill and steam derrick. The blocks are cut out by the channeling machine, which cuts to 5 feet 9 inches. The blocks are wedged out and lifted by the steam derrick. Drilling is done when necessary. A mill is run in connection with the quarry, where the stone is sawed, planed and rubbed for market. 37 men are employed during the quarrying season, which lasts from Mar. 15 to Nov. 30.

The stone is marketed chiefly in New York city. A side track runs into the quarry from the railroad. The price for block stone averages 60c a cubic foot. 42 to 43 carloads are shipped each month during the season.

Warsaw, Wyoming co.

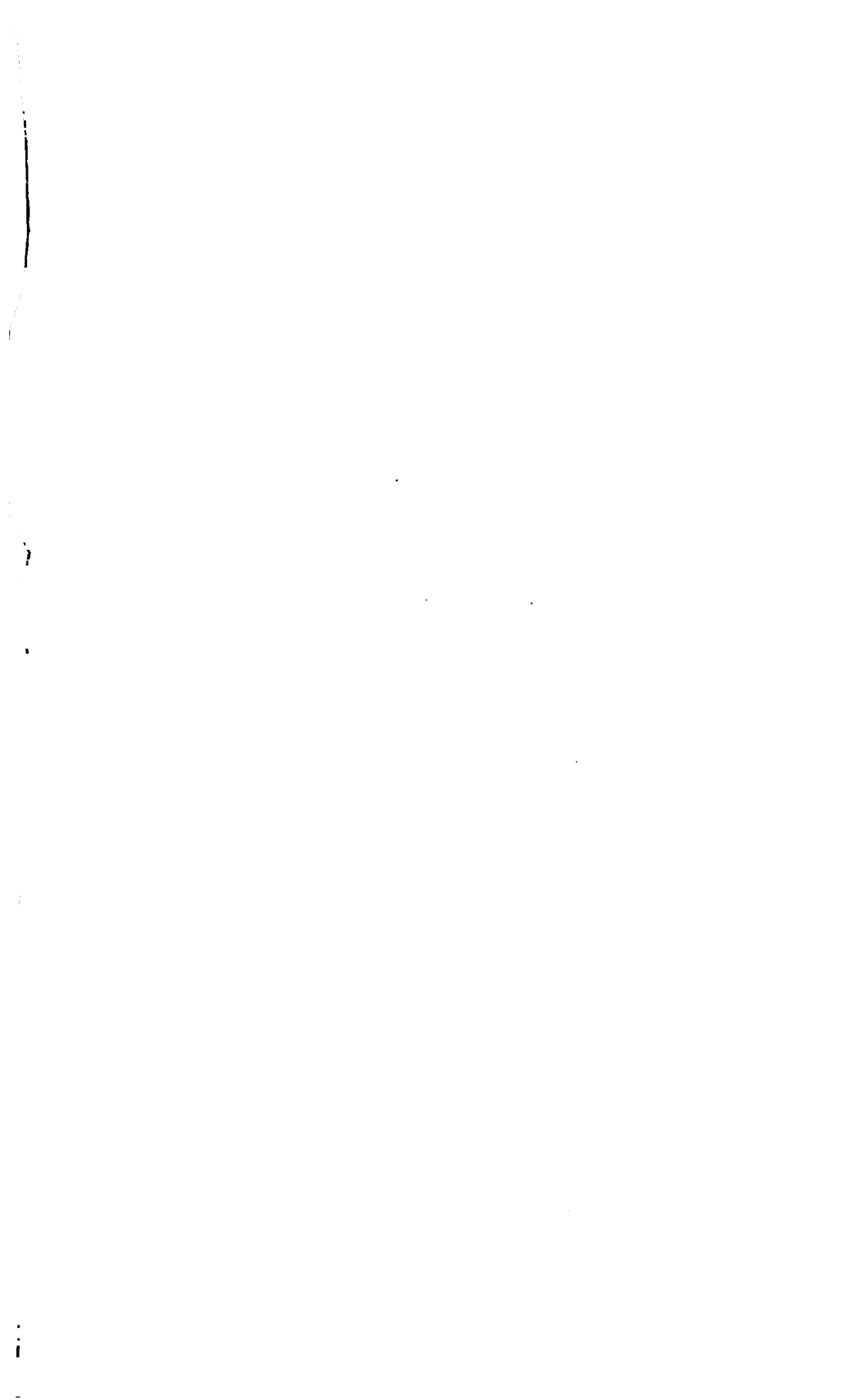
Stone known in the trade as Warsaw bluestone is quarried by two firms $3\frac{1}{2}$ miles south of Warsaw and 2 miles west of Rock Glen on the Erie railroad. Both quarries are on the same ledge of stone, within 25 yards of each other. The names of the firms are Warsaw bluestone co. and Otis & Gage. The latter firm has just begun operations this year.

The quarry formerly worked by the Warsaw bluestone co. at Rock Glen has been abandoned for some years, though the mill still stands and is connected with the present quarry by a railroad track. The bed of stone now worked is 35 feet thick. The top 5 feet are black rock and practically waste. The overburden consists of hardpan holding broken rock and is 15 feet thick. The bed is horizontal so far as can be seen. The lifts vary from 6 inches to 8 feet in thickness. In quality, color



H. T. Dickinson, photo.

Bluestone quarry of Warsaw bluestone co. at Rock Rift near Warsaw





H. T. Dickinson, photo.

Bluestone quarry of Otis and Gage at Rock Glen near Warsaw

and grain the stone is very similar to the Portage bluestone. It holds the color well on exposure and is easily worked.

The quarries are in the shape of irregular pits, the vertical joints forming the sides and ends. The blocks are cut, however, by channeling machines. The channel makes a cut 5 feet 9 inches in depth, $2\frac{1}{2}$ " wide at top and $1\frac{1}{4}$ " wide at the bottom; 18 to 20 linear feet can be cut every 10 hours. The level of the beds is below that of the surrounding country and water is very troublesome. It is handled by steam pumps.

The equipment of the Warsaw bluestone co. consists of a Wardwell channeling machine, three drills, a steam pump, two steam hoisting derricks; and a mill at Rock Glen with 12 gang saws, two planers, one borer, one circular saw, one lathe and four steam hoisting derricks. 45 men are employed in the quarry, and 20 men in the mill during the season.

Otis & Gage have a mill in course of erection within 100 yards of their quarry. A gravity railway connects the two. The mill is to be fully equipped with saws, planers, lathes etc. At the quarry there is in operation one Sullivan channeling machine, one steam drill, a steam hoisting derrick and a steam pump. 50 men are employed in quarry and mill.

Both mills are connected with the Erie railroad by side tracks. The market for this stone is in New York, Elmira, Corning, Binghamton, Philadelphia and Washington.

The following are examples of its use in construction: St Joseph's school at Buffalo; catholic school at Middletown; catholic church at Binghamton; armories at Brooklyn, Hudson, Hornellsville and Tonawanda; Vassar college at Poughkeepsie; residences at Corning, and the residence of N. S. Beardsley at Warsaw.

Waverly, Tioga co.

Gilbert Edgecomb's quarry is 2 miles north of Waverly, west of the Lehigh Valley railroad on a hillside. The quarry is 100 feet above the level of the valley. The height of the face at the back is 75 feet, and the length 125 feet in a north and south direction. The bed is covered with 4 feet of earth. The stone

is coarse grained, thin bedded and blue to gray in color. The product is rough building stone. It is used locally for foundations and in bridge building on the Delaware, Lackawanna and Western railroad. The quarry was opened in 1870.

Elmira, Chemung co.

The quarries are on the western face of the hill forming the eastern boundary of the valley between Horseheads and Elmira. Two quarries only are in active operation, but a number of openings have been made.

W. B. Pratt's quarry has been opened 50 years. The height at back is 40 to 60 feet. The bed of stone is not more than 25 feet thick and is thin bedded. It is covered with 25 feet of clay and shale top. The shale is made use of in the manufacture of paving brick. The stone is gray to very dark blue and fine grained. It is quarried by drilling deep holes and blasting. No dressing is done. The product is used for foundation work and cellar walls in Elmira. Six to seven men are employed during the season, which lasts seven or eight months in the year. A steam drill and hand derrick are part of the equipment.

A. Voight's quarry is $3\frac{1}{2}$ miles north of Elmira on the same range as Pratt's. The bed of stone is 20 to 25 feet thick, with shaly streaks running through it. The stripping is 14 to 16 feet thick, 10 feet of which are shale, the balance being drift earth.

The stone varies in color from red to blue. It is fine grained and very dense. The vertical jointing, as at Pratt's quarry, is north and south and east and west. The product is rough building stone which is used locally. A hand derrick is in use. Two to four men are employed. The price of stone in Elmira averages \$1 per perch.

On the hills bounding the valley of the Chemung river between Elmira and Big Flats, quarries have been opened on the lands of H. T. Clark and Sarah A. Conklin, but, owing to the long haul to market, are little worked.

QUARRIES IN THE SOUTHWESTERN COUNTIES

Corning, Steuben co.

But two quarries are being worked this season at Corning, though a number have been opened there in years past. Edward Kelly's quarry is situated $1\frac{1}{2}$ miles southwest of Corning on a hillside. The stone is fine grained and gray, specially in the upper part of the bed. In the lower part of the bed the stone has a pinkish blue appearance.

At the top are 30 feet of shale and dirt, in which there are a few courses of good stone. Below this are 8 feet of stone, which is blasted out and broken up for rough foundation work. This quarry has produced a better quality of stone, which was dressed and used in the reformatory buildings at Elmira and in the catholic church at Corning. The equipment consists of a hand derrick. Two to three men are employed according to demand.

George Barnard's quarry is $\frac{3}{4}$ of a mile southeast of Corning. The ledge has been opened up 250 feet in an east and west direction. The height of the face is 50 feet, of which 30 feet are shale and consequently worthless.

The lifts vary from 3 inches to 2 feet and are fairly regular. The stone is gray with a pink tinge, fine grained and somewhat reedy. The vertical joints are quite smooth and have an east and west direction. The product is all foundation stone and its market is local. The quarry is equipped with hand derrick.

A. I. Martin owns a quarry $\frac{1}{2}$ mile west of Mossy Glen, but it has not been worked for the last two seasons. The bed is 6 feet thick, with 6 feet of clay top. The stone is fine grained, bluish gray and reedy. It is used for foundation work.

Bath, Steuben co.

The quarry of W. and George Jinks is 2 miles northeast of Bath and 250 feet above the valley, on hillside. The height of the face at the back is 50 feet, of which 20 to 25 feet produce marketable stone, the upper 30 feet being shale and clay. The courses of stone vary in thickness from 3" to 18" and are inter-

stratified with shale. The strata are horizontal. The stone is fine grained and of a light gray color. It has been used for cut stone in the protestant episcopal church and county buildings at Bath, but is now quarried only for foundation work.

Just below this quarry another opening has been made in the hill. 15 feet of face are exposed, 8 feet of which are salable stone. The stone is gray, but has a whitish tinge. The lifts are somewhat heavier than in the quarry above.

The quarry of V. Holmes is situated $1\frac{1}{4}$ miles southwest of Bath. The ledge exposed is 45 feet thick. On top are 12 feet of clay and shale. Below this the courses of stone are interstratified with the shale. There are probably 8 feet of stone in the bed. The stone is fine grained and dark gray. It is quarried for cellar and rough work. It has not been worked the past season.

Near the Soldiers home at Bath stone has been quarried for the foundations of buildings and for road metal. The face is 125 feet high and 300 feet long. The sandstone is even bedded, of a gray color, and interstratified with shale. The vertical jointing is rough and irregular, but has a north and south and east and west direction. The dip is to the south and west and the lower strata are so covered with rubbish that it is impossible to determine the difference in quality of the stone in the beds.

Cohocton, Steuben co.

No quarries have been worked the past season at Cohocton on account of lack of demand for the stone.

Fred Zimmers's quarry lies $2\frac{1}{2}$ miles due west of Cohocton. The bed of stone, 4 feet thick, is covered with 15 feet of shale, in which some stone is interbedded. The product has been used for foundation work. The stone is fine grained and light gray. The quarry has not been worked for three years.

F. F. Woodworth's quarry is 3 miles northeast of Cohocton and two miles southeast of Atlanta, on a hillside 250 feet above the valley. 8 feet of shale and soil cover the 30 feet of stone courses, which vary in thickness from 3 inches to 2 feet. The



H. T. Dickinson, photo.

Sandstone quarry of F. F. Woodworth at Cohocton N. Y., not worked for some years

beds are nearly horizontal and divided by vertical joints, which run north and south and east and west, but are rough and irregular. The product is flag, which is sold locally and also shipped abroad by way of the Erie and Delaware, Lackawanna and Western railroads.

Dansville, Livingston co.

Only one quarry is worked at Dansville, that of Jacob Schubmehl, which is on the south end of hill which forms the eastern boundary of the valley in which Dansville lies. It is $2\frac{1}{2}$ miles southwest of the town above the Delaware, Lackawanna and Western railroad. The quarry face is 600 feet long, in an east and west direction, and 50 feet high. The top is of shale 15 feet thick, and beneath it shale and stone are interstratified. The stone is light gray and fine grained. In the lower courses the stone has a greenish tinge. The beds average $2\frac{1}{2}$ feet in thickness. There is an abundance of reeds or splitting planes in the stone. The product is chiefly rough foundation work, and the market a local one.

Hornellsville, Steuben co.

Two quarries are being worked at Hornellsville. James May's quarry is $1\frac{3}{4}$ miles south of the town on a hillside, 100 feet above the valley. Two openings, 7 rods apart, on the same ledge, are being worked. A vertical section shows 10 feet of clay and broken rock, and 20 feet of stone. The stone is fine grained and bluish gray in color. The bed dips to the southwest gently. The stone is divided by vertical joints running n. 50 e. and s. 40 w. The stone is susceptible to disintegration if quarried during cold weather. The product is chiefly common building stone for local consumption. Two to three men are employed during the year.

Joseph S. Cobb's quarry is in the same range as May's, and the stone is very similar. The face of the quarry is 900 feet long and 50 feet high at the back. There are 8 feet of stripping of clay, 25 feet of light blue sandstone (which is used for rough work) and 12 feet of blue gray stone. The lower bed is used for cut stone, and the trimmings in the Bryant & Park schoolhouse at Hornellsville are from this quarry. As the ledge is worked into the

hill, the lifts become very heavy and hard to handle. This is caused by the ledge being opened up such a long distance. Three men are employed during the year.

Belmont, Allegany co.

Leander Gordon and Eugene Pease own quarries near here. Gordon's quarries are $\frac{1}{2}$ mile northwest of the village. There are two openings: one near the road, producing flag, and one farther back for building stone. The flag quarry is very small. The stone is fine grained and gray. The bed is $4\frac{1}{2}$ feet thick, with 5 to 6 feet of dirt on top, and dips to the northwest. The lifts vary from 2" to 8". The flag is for local consumption. The quarry for building stone has a depth of bed of 18 to 20 feet, with 6 to 7 feet of shale overburden, in which some stone is interbedded. The stone is of the same quality as the flag quarry, but runs in heavier lifts, 12" to 24". The stone when cut has a pleasing appearance, but stains on exposure. The quarry has not been worked in some time.

The quarry of Eugene Pease is $2\frac{1}{2}$ miles southwest of Belmont. The bed is 12 feet thick, but the upper 10 feet are badly broken and are used only for common building stone. The lower 2 feet produce some cut stone. The stone is of medium grain and greenish gray. The top is 4 feet thick and of soil. The product is all sold locally.

Angelica, Allegany co.

William Tracy has opened a flag quarry $1\frac{1}{2}$ miles south of the village. It has been opened one year. The bed of stone is 4 feet thick, interbedded with shale. The lifts vary from 8" to 2 feet, and can be split. The stone is light gray and fine grained. The bed is nearly horizontal and is divided by a series of irregular vertical joints. The product is sold in Angelica, Belmont, and other neighboring villages.

Belvidere, Allegany co.

H. Whitcomb's quarry has not been worked in 10 years.

Cuba, Allegany co.

Jesse Adams works a quarry just south of the Erie railroad station. The length of face in an east and west direction is

500 feet, and the maximum height 30 feet. The bed is 8 feet thick, and dips to the south 1 in 7. The top of 10 to 22 feet is of shale, broken rock and dirt. In this there is some stone good enough for rough work. The stone is light gray and fine grained. The lifts vary from 2" to 12" in thickness. The product is used locally for common work.

Rockville, Allegany co.

Quarry of A. Searles 1 mile south of Rockville station. The bed of stone is 5 to 6 feet thick and is rough. 8 feet of soil and broken rock cover the bed. The stone is light gray and fine grained. The lifts vary from 6" to 12". The vertical jointing is northeast and southwest and northwest and southeast. Cross bedding appears in the bed. A line fence divided this quarry from Earl Herkimer's quarry, which is on the same ledge. The product is used locally in the surrounding towns for flagging and foundation work.

Belfast, Allegany co.

No quarry has been worked near Belfast in seven years.

Olean, Cattaraugus co.

The quarry of the Olean bluestone co. has been abandoned for five years, and the mill has been torn down.

John McCann is working a quarry $2\frac{1}{2}$ miles south of Olean in Wild Cat hollow. The bed of stone is 12 feet thick and is covered with a top of 8 feet of broken rock and soil. The stone is fine grained and has an oily appearance when first quarried, but turns light gray on exposure. The quarry face is 700 feet long and extends around the hill. The ledge has been worked this way to avoid the heavy top, in working into the hill. The lifts vary from 8" to 2 feet. The stone is used for common stone and curbing in Olean. The common stone sells for \$1.25 a perch and the curb for 18c a linear foot. Two to three men are employed.

Joseph Rounds quarries stone on the same ledge south of McCann.

Jamestown, Chautauqua co.

Six openings have been made in the eastern part of the town, in the hill on the right bank of the Chautauqua lake outlet,

and one on the left bank of the outlet. The latter quarry is that of the Jamestown shale paving brick co. This quarry was originally opened for building stone, but the amount of shale became so great that the brick works were built to dispose of it. Now the quarrying of the stone for building is a minor affair. The ledge opened is 62 feet thick. The upper 25 feet are of shale and thin layers of stone, all of which is used for making brick. Below occurs the stone for building purposes. The stone is bluish, fine grained, and hard. The vertical joints are at irregular distances apart.

The systems run n. 30 w. and s. 55 w., the first being vertical, the second pitching steeply to the northwest. The lifts vary from 6" to 14". The product includes common building stone and cut work. It is sold in Jamestown for \$6 to \$7 a cord.

The quarries on the right bank of the outlet are at irregular intervals, the distance from the first to the last being about $\frac{1}{4}$ of a mile. They have been worked extensively at one time, but are small producers now. The maximum height of face exposed is 65 feet. Below the top 5 feet of earth, stone and shale are interbedded. The upper courses produce only common building stone, while the lower beds are thicker, of better color and grain, and are cut for house trimmings for local market. No machinery of any kind is in use, but three of the openings are provided with hand derricks.

Watts Flats, Chautauqua co.

No quarries are in operation here.

North Clymer, Chautauqua co.

Two quarries on the same ledge have been worked $\frac{1}{2}$ mile east of the railroad station. The bed of stone is 20 feet thick, but the top 4 feet are too rough for good stone. Above the bed are 3 feet of earth. The lifts vary from 1 foot to $3\frac{1}{2}$ feet. The bed dips gently to the northeast. The stone is light gray and fine grained, and liable to weather badly. The quarries are owned by P. J. Reed and B. P. Smith, but have not been worked for three seasons.

This stone has been used for bridge abutments in Buffalo and on the Buffalo, Rochester and Pittsburg railroad.

Westfield, Chautauqua co.

Albert Elliott's quarry. A small quarry situated 2 miles northeast of Westfield and $\frac{1}{4}$ of a mile south of Lake Erie. The top of earth 4 to 5 feet thick covers a bed of stone 3 feet thick, with seams 2" to 3" apart. The stone is fine grained and blue gray. Some shale is interbedded with the stone, which latter has been used in arches for bridges and foundations. The quarry is very small and is worked only intermittently.

Laona, Chautauqua co.

Several quarries have been opened here on a line running northwest and southeast, which passes just north of Laona. Five or six quarries are on this line, but the only quarry that has been worked for some time is that of George R. Moore. This quarry is $1\frac{1}{2}$ miles northwest of Laona. The opening is in an open field. The bed of stone is 5 feet thick, with top of 6 to 8 feet, 2 feet of which are shale, and the balance earth. The stone is fine grained and grayish blue. The lifts vary from 3" to 6" and are rather rough. The product is used for foundations in Dunkirk and Fredonia. 500 cords of stone worth \$6 a cord at the quarry have been taken out of the quarry the past season.

John Wagner's quarry is the most southern on the belt and is just north of Laona. It has not been worked for a few years. It was opened 40 years ago. Some cut stone for trimmings has been produced from this quarry.

Franklinville, Cattaraugus co.

There is a sandstone quarry here which was not visited. No details are known.

Reorganization in the Hudson river valley

The bluestone interests in the vicinity of Rondout are now controlled by the following firms: Hudson river bluestone company, Malden, Saugerties, Glasco, Rondout, Brodheads Bridge and Wilbur; John Maxwell, yards at Saugerties, Glasco and Catskill; J. J. Sweeney & Son, Saugerties; and E. Riseley, West Hurley.

The Hudson river bluestone company has absorbed the business of Hewitt Boice, Rondout; Julius Osterhoudt, Wilbur; J. J. Sweeney, Wilbur; Rogers and Tappan, Wilbur and T. J. Dunn & Co., Malden. This company is working its own quarries at Cold Brook, Mt Pleasant, Arkville and Kingston. These quarries are all fitted with steam derricks and drills, employ about 300 men and operate 15 barges. Yearly value of business, \$500,000.

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New York State Museum

MUSEUM PUBLICATIONS

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Museum annual reports 1847-date. *All in print to 1892, 50c a volume, 75c in cloth; 1892-date, 75c, cloth.*

These reports are made up of the reports of the director, geologist, paleontologist, botanist and entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Geologist's annual reports 1881-date. Rep'ts 1, 3-13, 17-date, O.; 2, 14-16, Q.

The annual reports of the early natural history survey, 1837-41 are out of print. Reports 1-4, 1881-84 were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

<i>Report</i>	<i>Price</i>	<i>Report</i>	<i>Price</i>	<i>Report</i>	<i>Price</i>
12 (1892)	\$.50	16	\$1	19	\$.40
14	.75	17	.75	20	.50
15	1	18	.75		

In 1898 the paleontologic work of the State was made distinct from the geologic and will hereafter be reported separately.

Paleontologist's annual reports 1899-date.

See fourth note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Since 1901 these reports have been issued as bulletins.

Botanist's annual reports 1869-date.

Bound also with museum reports 22-date of which they form a part; the first botanist's report appeared in the 22d museum report and is numbered 22.

Reports 22-50 and 52 (Museum bulletin 25) are out of print. Report 51 may be had for 40c; 53 for 20c; 54 for 50c; 55 (Museum bulletin 54) for 40c. Since 1901 these reports have been issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have been published in volumes 1 and 3 of the 48th museum report and in volume 1 of the 49th, 51st, 52d, 53d, 54th and 55th reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and combined with others more recently prepared and constitute Museum memoir 4.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882-date.

Reports 3-17 bound also with museum reports 40-46, 48-55 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3-4 are out of print, other reports with prices are:

<i>Report</i>	<i>Price</i>	<i>Report</i>	<i>Price</i>	<i>Report</i>	<i>Price</i>
1	\$.50	8	\$.25	13	\$.10
2	.30	9	.25	14 (Mus. bul. 23)	.20
5	.25	10	.35	15 (" 31)	.15
6	.15	11	.25	16 (" 36)	.25
7	.20	12	.25	17 (" 53)	.30

Reports 2, 8-12 may also be obtained bound separately in cloth at 25c in addition to the price given above.

Museum bulletins 1887-date. O. *To advance subscribers \$2 a year or 50c a year for those of any one division: (1) geology, including economic geology, general zoology, archeology and mineralogy, (2) paleontology, (3) botany, (4) entomology.*

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Bulletins are also found with the annual reports of the museum as follows :

<i>Bulletins</i>	<i>Report</i>	<i>Bulletins</i>	<i>Report</i>	<i>Bulletins</i>	<i>Report</i>
12-15	48, v. 1	20-25	52, v. 1	35-36	54, v. 2
16-17	50 "	26-31	53 "	37-44	" v. 3
18-19	51 "	32-34	54 "	45-48	" v. 4

The letter and figure in parenthesis after the bulletin number indicate the division and series number. G=geology, EG=economic geology, Z=general zoology, A=archeology, M=mineralogy, F=paleontology, B=botany, E=entomology, Misc=miscellaneous.

Volume 1. 6 nos. \$1.50 in cloth

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- 2 (B1) Peck, C: H. Contributions to the Botany of the State of New York. 66p. 2pl. May 1887. [35c]
- 3 (EG1) Smock, J: C. Building Stone in the State of New York. 152p. Mar. 1888. *Out of print.*
- 4 (M1) Nason, F. L. Some New York Minerals and their Localities. 20p. 1pl. Aug. 1888. 5c.
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- 6 (E2) ——— Cut-worms. 36p. il. Nov. 1888. 10c.

Volume 2. 4 nos. [\$1.50] in cloth

- 7 (EG2) Smock, J: C. First Report on the Iron Mines and Iron Ore Districts in New York. 6+70p. map. June 1889. *Out of print.*
- 8 (B2) Peck, C: H. Boleti of the United States. 96p. Sep. 1889. [50c]
- 9 (Z2) Marshall, W: B. Beaks of Unionidae Inhabiting the Vicinity of Albany, N. Y. 24p. 1pl. Aug. 1890. 10c.
- 10 (EG3) Smock, J: C. Building Stone in New York. 210p. map. tab. Sep. 1890. 40c.

Volume 3. 5 nos.

- 11 (EG4) Merrill, F: J. H. Salt and Gypsum Industries in New York. 92p. 12pl. 2 maps, 11 tab. Ap. 1893. 40c.
- 12 (EG5) Ries, Heinrich. Clay Industries of New York. 174p. 2pl. map. Mar. 1895. 30c.
- 13 (E3) Lintner, J. A. Some Destructive Insects of New York State; San José Scale. 54p. 7pl. Ap. 1895. 15c.
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Volume 5

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MUSEUM PUBLICATIONS

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Museum memoirs 1889-date. Q.

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2 Hall, James & Clarke, J. M. Paleozoic Reticulate Sponges. 350p. il. 70pl. 1898. \$1, cloth.

3 Clarke, J. M. The Oriskany Fauna of Becraft Mountain, Columbia Co. N. Y. 128p. 9pl. Oct. 1900. 80c.

4 Peck, C. H. N. Y. Edible Fungi, 1895-99. 106p. 25pl. Nov. 1900. 75c. This includes revised descriptions and illustrations of fungi reported in the 49th, 51st and 52d reports of the state botanist.

5 Clarke, J. M. & Ruedemann, Rudolf. Guelph Formation and Fauna of New York State. *In press.*

6 Clarke, J. M. Naples Fauna in Western New York. *In press.*
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UNIVERSITY OF THE STATE OF NEW YORK

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- v. 8 pt1 Introduction to the Study of the Genera of the Paleozoic Brachiopoda. 16+367p. 44pl. 1892. \$2.50.
— pt2 Paleozoic Brachiopoda. 16+394p. 84pl. 1894. \$2.50.

Museum handbooks 1893-date. 7½x12½ cm.

In quantities, 1 cent for each 16 pages or less. Single copies postpaid as below.

H5 New York State Museum. 14p. il. 3c.

Outlines history and work of the museum; with list of staff and scientific publications, 1893. *New edition in press.*

H13 Paleontology. 8p. 2c.

Brief outline of State Museum work in paleontology under heads: Definition; Relation to biology; Relation to stratigraphy; History of paleontology in New York.

H15 Guide to Excursions in the Fossiliferous Rocks of New York. 120p. 8c.

Itineraries of 32 trips covering nearly the entire series of Paleozoic rocks, prepared specially for the use of teachers and students desiring to acquaint themselves more intimately with the classic rocks of this State.

H16 Entomology. 12p. 2c.

H17 Economic Geology. *In preparation.*

Maps. Merrill, F: J. H. Economic and Geologic Map of the State of New York. 59x67 cm. 1894. Scale 14 miles to 1 inch. *Out of print.*

New edition in preparation.

Printed also with Museum bulletin 15 and the 48th museum report, v. 1.

— Geologic Map of New York. 1901. Scale 5 miles to 1 inch. *In atlas form \$3; mounted on rollers \$5. Lower Hudson sheet 60c.*

The lower Hudson sheet, geologically colored, comprises Rockland, Orange, Dutchess, Putnam, Westchester, New York, Richmond, Kings, Queens and Nassau counties, and parts of Sullivan, Ulster and Suffolk counties; also north-eastern New Jersey and part of western Connecticut.

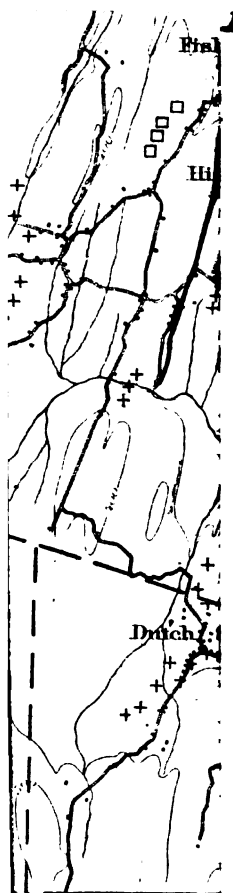


PLATE :

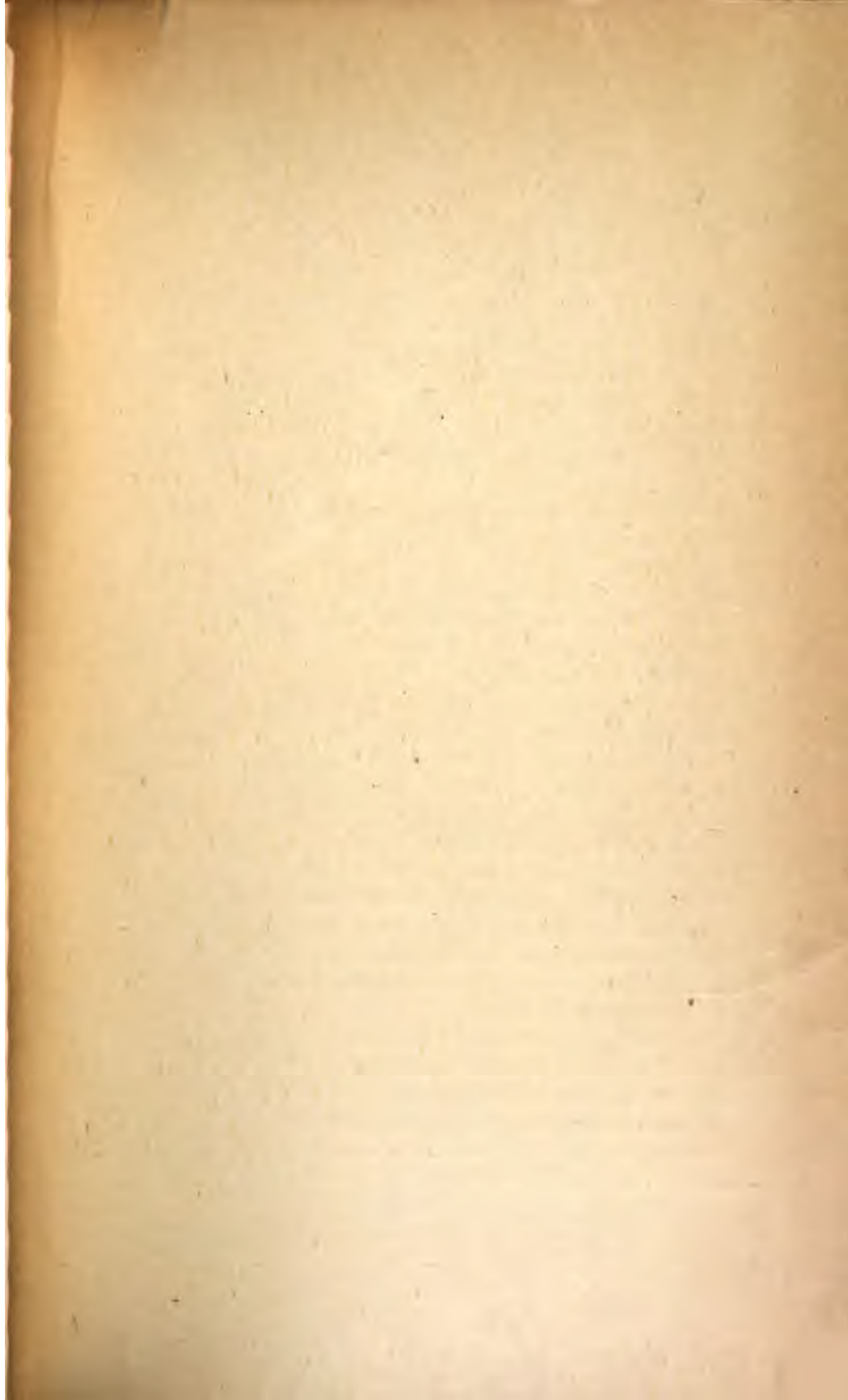
Map of New York state showing location of bluestone quarries

PLATE :

Map of Eastern Catskills showing location of bluestone quarries



Miles



New York State Museum

The New York State Museum as at present organized is the outgrowth of the Natural History Survey of the State commenced in 1836. This was established at the expressed wish of the people to have some definite and positive knowledge of the mineral resources and of the vegetable and animal forms of the State. This wish was stated in memorials presented to the Legislature in 1834 by the Albany Institute and in 1835 by the American Institute of New York city and as a result of these and other influences the Legislature of 1835 passed a resolution requesting the secretary of state to report to that body a plan for "a complete geological survey of the State, which shall furnish a scientific and perfect account of its rocks, soils and materials and of their localities; a list of its mineralogical, botanical and zoological productions and provide for procuring and preserving specimens of the same; etc."

Pursuant to this request, Hon. John A. Dix, then secretary of state, presented to the Legislature of 1836, a report proposing a plan for a complete geologic, botanic and zoologic survey of the State. This report was adopted by the Legislature then in session and the governor was authorized to employ competent persons to carry out the plan which was at once put into effect.

The scientific staff of the Natural History Survey of 1836 consisted of John Torrey, botanist; James E. De Kay, zoologist; Lewis C. Beck, mineralogist; W. W. Mather, Ebenezer Emmons, Lardner Vanuxem and Timothy A. Conrad geologists. In 1837 Professor Conrad was made paleontologist and James Hall, who had been an assistant to Professor Emmons, was appointed geologist to succeed Professor Vanuxem, who took Professor Conrad's place.

The heads of the several departments reported annually to the governor the results of their investigations, and these constituted the annual octavo reports which were published from 1837 to 1841. The final reports were published in quarto form, beginning at the close of the field work in 1841, and 3000 sets have been distributed, comprising four volumes of geology, one of mineralogy, two of botany, five of zoology, five of agriculture and eight of paleontology.

JUN 21 1933

S-72-2

Published monthly by the

University of the State of New York

BULLETIN 62

APRIL 1903

New York State Museum

FREDERICK J. H. MERRILL Director

11,983

Bulletin 62

MISCELLANEOUS 1

NATURAL HISTORY MUSEUMS

OF THE

UNITED STATES AND CANADA

BY

FREDERICK J. H. MERRILL

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ALBANY

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1903

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University of the State of New York

New York State Museum

FREDERICK J. H. MERRILL Director

Bulletin 62

MISCELLANEOUS 1

NATURAL HISTORY MUSEUMS

OF THE

UNITED STATES AND CANADA

PREFACE

The lack of general and specific information concerning the natural history museums of this country and their collections has made it seem important to collate for publication all facts concerning these educational mediums which could be obtained directly or otherwise.

With this aim, circular letters have been sent to all institutions where collections or museums exist, asking for full details. From the replies received, the following directory has been compiled and while many errors and omissions may be found in this first edition, the aid of museum curators and administrative officers throughout the country is solicited, in the attempt to make the publication accurate and reliable.

To my assistants Mr J. N. Nevius and H. H. Hindshaw, who have greatly aided me in the compilation, I desire to express my obligations.

FREDERICK J. H. MERRILL

Albany, July 1902

UNITED STATES

ALABAMA

Alabama polytechnic institute museum, Auburn. P. H. Mell, *director state experiment station* in charge; G. F. Boyd, *assistant*. The fire that destroyed the main building in 1887, swept away the museum which contained a very full representation of all branches of science and was one of the best in the south.

Paleontology. Several hundred specimens representing several formations including the Claiborne of this state; a small collection of fossils from the Paris basin representing to some extent the different formations.

Mineralogy. 600 specimens.

Historic and economic geology and lithology. 100 specimens.

Zoology. 75 specimens, a few representing the local fauna.

Botany. 40,134 specimens: 16,950 fungi; 1006 lichens; 588 algae; 20,606 flowering plants.

Ethnology and anthropology. A few specimens.

Geological survey of Alabama, University. Eugene A. Smith, *state geologist*; Henry McCalley, *assistant*.

Geology and paleontology. About 75,000 specimens comprising about 15,000 catalogue titles: three fourths illustrative of Alabama geology, and the remainder of a general nature.

Mineralogy. 4800 specimens.

Zoology. 8100 specimens: 900 skins of Alabama birds; 200 fishes and other marine forms; and 7000 recent shells.

Botany. 4300 Alabama plants, flowering plants and cryptogams about equally represented: 1000 foreign plants mostly cryptogams.

Ethnology. 435 relics of North American Indians.

Total. 26,000 entry titles, and 94,000 specimens.

Howard college, East Lake. No report.

Southern university, Greensboro.

Small general collection.

ARIZONA

University of Arizona, Territorial museum, Tucson. Herbert Brown and professors in various departments, *curators*.

Paleontology. Collections of Arizona fossils, Devonian corals, etc. Horn cores of *Bos arizonica*.

Mineralogy. 2500 specimens: a series illustrative of the physical properties of minerals, showing color, luster, hardness, etc.; miscellaneous specimens, principally ores of the useful metals, from Arizona localities; a series of copper minerals from the Copper Queen mine at Bisbee; some foreign material, and the 86 pound Weaver meteorite.

Economic geology. Copper ores from Bisbee, ores and metallurgic specimens from the gold, silver and lead mines of the territory; gypsum clays, cement, and a partial series of building stones.

Lithology. 3000 specimens: illustrating the rock formations of the territory; collection of typical rock species purchased from Krantz of Bonn, and a suite from the United States geological survey.

Zoology. 1500 specimens: a miscellaneous representation of mammals, birds and reptiles, mostly from Arizona, including the Brown collection of 1200 skins of Arizona birds.

Botany. 10,000 specimens, United States and Mexican plants. 2500 specimens in the botanical survey herbarium illustrating the Arizona flora. A special feature of the herbarium is its completeness in the order Cactaceae represented by more than 1000 mounted specimens and as many more unmounted duplicates.

Ethnology and archeology. Specimens of ancient and modern aboriginal pottery from the pueblos and cliff houses of Arizona. Stone implements. Historic relics of the Spanish conquest. Skulls, clay images. Suites of figures illustrating the dress of the Yuma Indians and Mexicans.

ARKANSAS

Hendrix college museum, Conway. G. L. Harrell, *director*.

Mineralogy. 800 specimens arranged in economic groups and including gold, silver, lead, zinc, iron, copper, antimony, calcium barium and silicon. Specimens include native gold, native silver

and galena from Colorado; sphalerite, smithsonite, pyrite, malachite and stibnite from Arkansas; antimony and calcite from England, Bohemia and Mexico; smithsonite from Greece; stibnite from Utah.

Historic and economic geology and lithology. 72 specimens: representative of the Carboniferous, Subcarboniferous, Niagara and Trenton.

Zoology. 100 specimens: serpents, insects and mollusks.

University of Arkansas museum, Fayetteville. A. H. Purdue, professor of geology.

Paleontology. 1800 specimens: 300 vertebrates; 1000 invertebrates and 500 plants.

Mineralogy. 2000 specimens: 200 mineral species, mostly oxids, sulfids and silicates.

Economic geology. 50 specimens of building stones; 200 specimens representing the carbonates, sulfids, oxids and silicates.

Petrography. 300 specimens.

Historic geology. 13 relief maps.

Zoology. 2900 specimens: 80 species of mammals and birds (200 specimens); 40 species of reptiles and amphibians (200 specimens) and 18 skeletons; 350 species of fish (1500 specimens); 200 species of insects and other invertebrates (1000 specimens).

Botany. 3500 specimens, illustrating 1500 species.

CALIFORNIA

California academy of sciences, San Francisco. See Addenda, p. 221.

Golden Gate Park museum, San Francisco. C. P. Wilcomb, curator.

Collections are small as this museum is only six years old. It consists of 25 distinct departments and is in a well equipped building.

Paleontology. 2000 specimens and 250 species of fossils.

Mineralogy. 2322 specimens.

Zoology. 24,000 specimens: mammals, birds, fishes and miscellaneous objects of natural history.

Botany. 404 specimens in forestry.

Ethnology. 3416 specimens.

Leland Stanford Junior museum, Stanford University. Harry C. Peterson, *curator*; Edwin A. Austin, *assistant curator*; Daniel V. Noland, *assistant graphic arts*; George M. Shindo, *assistant Japanese dep't*; T. Shibata, George Slade, Robert Godwin, Adelin Martin, *museum assistants*.

Mineralogy. Principally Pacific coast specimens, also collection of Ural mountain ores.

Zoology. A representative collection of birds, birds eggs, seals, etc.

Ethnology. Series of Di Cesnola's material from Cyprus; Indian remains and fabrics, Alaskan material, very complete collection of stone age specimens from Denmark; a comprehensive collection of Chinese, Japanese and Korean material, also Egyptian, Assyrian, Sudanese and Bisharin collections.

Archeology. Large collections of fine arts, nearly all the gift of Mrs Stanford.

Leland Stanford Junior university, Stanford University. Museum staff: Charles H. Gilbert, *professor of zoology*, in charge of museum; Edwin C. Starks, *curator*; Michitaro Lindo, *assistant*.

Paleontology. Californian Carboniferous, Californian Triassic, Californian Cretaceous, Californian Tertiary and marine Pleistocene, each with large quantity of undescribed material. Not yet listed, but specially full for Triassic, Tertiary and Pleistocene. Chiefly invertebrates. Yates collection of invertebrates and the Law collection of Mollusca are deposited with the department of geology and used constantly in instruction.

Specimens of Carboniferous, Cretaceous, Tertiary and Pleistocene (all invertebrates) of California for exchange.

Mineralogy. Collection illustrating the minerals of the crystalline rocks of New England; local set illustrating the rock-forming minerals of California.

Historic and economic geology. Zinc and lead ores of Missouri; building stones and clays of Arkansas; U. S. geological survey, Eureka, Nevada set; gold and silver ores, manganese ores of Brazil, Arkansas and Georgia; phosphate rocks of the United States.

Lithology. Set illustrating the types of igneous rocks of California, specially complete in granitic rocks. Igneous rocks of Arkansas; igneous and metamorphic rocks of Brazil, Wisconsin and Michigan. Set illustrating the metamorphic rocks of California; a set illustrating the geology of the Lake Superior region. U. S. geological survey educational set of rocks. Collections of crystalline rocks from various parts of the west. Some specimens of the crystalline rocks of California for exchange.

Zoology. Collections consist of 15,346 jars of fishes entered besides large collections of Japanese, Hawaiian and Philippine collections not entered; 1100 jars of batrachians; 5000 jars of reptiles; 5317 bird skins; 2400 mammal skins; 250 fish skeletons. Invertebrate collections not entered. In entomology, 260 trays of mounted insects, a cabinet of alcoholic specimens, about 5000 microscope slides illustrating development and variation, special collections from Japan, Galapagos and Samoan islands, a large collection of Coccidae and the most important existing collection of Mallophaga. Specimens of vertebrates and invertebrates for exchange.

Botany. Mounted sheets chiefly Pacific North American plants; unmounted specimens of all observed spermatophytes on Santa Cruz Mt peninsula. Deposited by professor of botany, 1) collection of California plants chiefly from Inland, Nevada and Monterey counties; 2) collection of plants of central New York—spermatophytes to fungi; 3) collection of marine algae from Woods Hole. Some specimens of California spermatophytes for exchange.

San Diego society of natural history, San Diego. Daniel Cleveland, *president*.

Small collections of geologic material.

Santa Clara college museum, Santa Clara. A. Cichi in charge.

Paleontology. 1000 specimens: Ward's college collection; a good collection of corals and some of Von Zittel's charts.

Mineralogy and geology. 2300 specimens: 250 specimens from France; 1020 specimens from Germany, and over 1000 specimens of ores from California and Nevada mines.

Zoology. Collection of skulls of different classes of mammals; 120 alcoholic specimens of invertebrates from Lenoir & Forster, Vienna; 101 Leuchardt charts; 100 Gerold's charts.

Botany. 1500 specimens of plants and a fine collection of Brondel's models in hardened gelatin, illustrating specially the fertilization of cryptogams, mosses, molds, bacteria, etc.

Ethnology and anthropology. A collection of skulls of the different races of men.

The museum also contains a collection of relief maps.

State mining bureau, San Francisco. L. E. Aubury, *state mineralogist*; J. M. Cline, *curator*.

15,750 specimens: ores, minerals, rocks, etc., principally from California and the Pacific coast, but to a small extent representing the whole world.

One side of the museum is devoted to California. Collections are arranged by counties and districts; and there are 32 cases of gold quartz, five of silver ores, five of copper, four of quicksilver, one of iron, one of chrome iron ore, and two of the ores of manganese, antimony, lead, zinc, etc. Marbles and building stones of the state are also represented.

On the opposite side of the museum are 34 cases of crystallized minerals, largely from California, but also foreign. These are arranged mineralogically: two cases of iron, two of copper, one of manganese ores, etc.

There is also a series of economic minerals, such as borax, niter, sulfur, alum, crude and refined oils, asphalt, coals, clays, gypsum, etc., chiefly from California, arranged to show the state resources.

The vestibule is largely devoted to paleontology, and contains some ethnologic and historic specimens.

There are also many models of mining machinery and mine timbering, photographs and maps.

University of California, Berkeley. J. C. Merriam *professor of paleontology*; A. C. Lawson *professor of mineralogy and geology*; W. E. Ritter *professor of zoology*; William Albert Setchell *professor of botany*; A. L. Kroeber *professor of ethnology and archeology*.

The heads of the various departments are in charge of the collections.

Paleontology. Collections made by the California geological survey: type or representative specimens of all known California fossils; splendidly preserved fossils illustrating the paleontology of the state; a large series illustrating the development of invertebrate life in North America and a carefully selected series of crinoids from Crawfordsville Ind.

Mineralogy. A very large systematic collection and a series of glass and wooden crystal models.

Economic geology. Sets of specimens from mines on the Pacific coast: gold, silver, mercury, iron, copper and coal, showing for each mine the ores, veinstones, wall rock, and other important features.

Structural geology. Fine models of the more interesting geologic regions, chiefly in the United States containing an excellent relief map of the peninsula of San Francisco from $37^{\circ} 30'$ to the Golden Gate, on a scale of 2 inches to the mile.

Lithology. Many hundred rock specimens from the eastern states and territories, England and the European continent, and a large number of California rocks collected by the state geological survey; also 3600 slides for microscopic study.

Zoology. Good collections of both invertebrates and vertebrates. The collections of marine invertebrates from the Pacific coast, specially of the groups Coelenterata, Crustacea, Echinodermata, Annelida, Bryozoa, and Tunicata, are rich and are being rapidly increased. There is a large type collection of California molluscan shells, and besides a general collection in the same group of 2300 specimens. In entomology the agricultural department possesses a collection of over 2000 determined species of beetles. There is also a large collection of Lepidoptera. The collections of amphibians, reptiles, birds and mammals are fairly representative of the California fauna in these groups. The collection of Alaska birds and mammals is good. The collection of vertebrate skeletons has been greatly enriched recently through a gift of about 50 new types. These were

selected with the view of supplementing the forms already possessed; and the collection of types is now complete for the purposes of general instruction in comparative anatomy. The large Alaskan collections recently given to the university by the Alaska Commercial Company have been recently transferred to the new ferry building in San Francisco for temporary exhibition, and the natural history specimens are there available for study by students carrying on investigations.

Botany. Some thousands of specimens of California plants, of which over a hundred are new species; a representation of woods, cones and tree photographs; several hundred specimens from the southern part of the state; a herbarium of the United States grasses; an excellent representation of the flora and silva of the southern Atlantic states; 1000 specimens from Oregon, Washington and North Dakota; a fine representation of the Australian flora; several thousand specimens from eastern United States; 4000 specimens of ferns, mosses, hepaticas, marine algae, fungi, etc., and also the algae, fungi and lichens of Prof. Setchell.

Ethnology and archeology. Many stone implements and skeletons obtained from mounds and river gravels of the Pacific coast, some presented by D. O. Mills and many more recently collected by various expeditions sent out by Mrs Phebe A. Hearst; wooden and stone implements, and other articles illustrating the manners and customs of the people of the Pacific islands, presented by F. L. A. Pioche; rich Peruvian collections; Indian utensils, a series of models of the cliff dwellings of New Mexico and Arizona. Recently the Alaska Commercial Company has presented to the university its collection illustrative of the habits of life of the Eskimos of Alaska and the Behring sea. This collection has been in process of accumulation for many years, and is very rich. Extensive collections in Egyptian archeology are being constantly received from investigations carried on in Egypt through the support of Mrs Phebe A. Hearst.

The collections belonging to the university were obtained from several sources. 1) The state geological survey contributed the

extensive collection of minerals, fossils, marine and land shells, and skins of California birds which were the type specimens of the species described in its ornithologic report; a set of Ward casts of selected types of the larger fossils was added later. 2) The Pioche collection of South American shells, fossils, minerals and ores illustrative of Pacific coast forms. 3) California land shells and native ores and rocks from D. O. Mills. 4) A costly mineral collection of James R. Keene. 5) The expeditions of the various natural history departments. Type specimens of new species and specimens illustrating various facts in the natural history of California's marine fauna are placed in the museum. 6) The extensive collections in Alaskan ethnology and natural history from the Alaska Commercial Company. 7) The explorations in Egypt, Greece, Peru and California conducted at the expense of Mrs Phebe A. Hearst.

University of southern California, University station, Los Angeles. Albert B. Ulrey, *professor of biology*.

Palaeontology. 2950 specimens which are now being arranged for exhibition. Material for exchange.

Mineralogy. 3700 specimens. Material for exchange.

Historic and economic geology and lithology. 1000 specimens.

Zoology. 22,300 specimens: 525 birds and 125 birds eggs, 350 other vertebrates including a fairly large series of fishes and Kansas snakes; series of corals and other marine invertebrates; a small collection of insects, and 19,500 mollusks. A complete collection of vertebrates from the island of Santa Catalina is being made.

Botany. 5000 specimens; collectors are now at work in the interest of this department. Material for exchange.

Ethnology. 730 specimens. Material for exchange.

COLORADO

Bureau of mines of the state of Colorado, capitol, Denver. Harry A. Lee, *commissioner*.

The collections are all of an economic and mineralogic nature including a complete collection of the minerals and ores of the

state of Colorado, arranged by counties; a series of its coal, coke and iron products; samples of the massive ores of the various mines in the state and the Dr Ellsner collection of minerals from all parts of the world.

Colorado college and Cutler academy, Colorado Springs. No report.

Colorado scientific society, Boston building, Denver.

Classified collection of minerals, rocks and fossils on exhibition daily except Sunday.

Colorado school of mines, Golden. H. B. Patton, *professor of geology and mineralogy*, in charge.

Paleontology. A display collection mainly of fossils, 342 specimens and a miscellaneous collection of 1360 specimens.

Mineralogy. A display collection of Colorado minerals, 1305 specimens; a type collection, 3700 specimens; a supplementary collection of the rarer species, 950 specimens; a working collection of 21,000 specimens; and a crystallographic collection of 950 specimens; the R. C. Hills collection of minerals, a collection of the coals of Colorado, Wyoming and New Mexico, 800 hand specimens and slides of Colorado and New Mexico eruptive rocks. Prof. Patton's private collection of 970 specimens is displayed.

Historic and economic geology and lithology. A type collection of rocks consisting of a) a general collection b) a series of Colorado rocks, 1800 specimens; a working collection of 17,400 specimens and the U. S. geological survey educational series of rocks, 156 specimens. Prof. Patton's private collection of 1700 lithologic specimens is also exhibited.

The museum has many specimens to exchange.

Mining and metallurgy. Excellent set of models of furnaces, mills, crushers, with models of mines, examples of timbering, etc.

State agricultural college, Fort Collins.

The collections are in charge of the heads of the several departments: W. P. Headden, *paleontology and mineralogy*; Wendell

Paddock, *botany and horticulture*; and Clarence P. Gillette, *zoology*, in charge.

Paleontology. About 550 choice specimens.

Mineralogy. 400 typical specimens.

Lithology. 1672 hand specimens of rocks.

Economic geology. 1000 specimens of ores.

Zoology. 60,000 specimens, including 55,000 insects exhibited in good form for study. Also 13 mounted skeletons of vertebrates; a number of skulls; 75 mounted mammals, 300 mounted birds; 60 bird skins and 700 birds eggs; a mounted collection, 300 specimens, of sponges, corals, mollusks and crustaceans. Also an economic collection of 200 specimens of plants injured by insects, and 200 honey-bearing plants; a series of wax models illustrating the segmentation of the egg and the development of the chick; and models of several parts of the human body, including the eye, ear, throat and larynx. A large number of Colorado insects are for exchange.

Botany. 7000 specimens: 1000 species of Colorado phanerogams and 2500 from other states; 300 species of Colorado fungi and 2000 from other states. 4000 specimens for exchange.

Ethnology. Small collection.

University of Colorado museum, Boulder. Nevin M. Fenneman, *professor of geology*, and Francis Ramaley, *professor of biology*, are in charge of the collections.

Paleontology. 500 partly labeled specimens.

Mineralogy. 700 exhibition specimens, a study set of about 400 mineral specimens, and 75 microscope slides of minerals. In the economic collections is a set of 600 specimens of characteristic ores of Colorado particularly rich in tellurids.

Lithology. 400 specimens of typical rocks; 140 specimens of typical rocks of Cripple creek region (the G. H. Stone collection); the United States geological survey educational series of rocks; 75 specimens illustrating geologic structure; and 360 microscopic slides of typical rocks.

Zoology. 600 specimens: a series of vertebrate skeletons; a set of North American fishes, from the Smithsonian institution;

a fairly complete set of invertebrates, both alcoholic and dry specimens; besides 1000 microscope slides in zoology, embryology and histology. This material is reserved for class use almost exclusively, and to give thorough training in laboratory work.

Botany. 4000 herbarium specimens: a large amount of alcoholic material, representing all groups of plants, for laboratory use; many West Indian, west American and Mediterranean algae; a good selection of microscope slides, specially of rare material in anatomy and cytology.

University of Denver, Denver.

No report.

CONNECTICUT

Connecticut agricultural college, Storrs. Rufus W. Stimson in charge.

Paleontology. 500 specimens.

Mineralogy. 700 specimens.

Historic and economic geology and lithology. 900 specimens.

Zoology. 10,000 specimens: representing nearly every group of the animal kingdom. 50 to 75 species of marine invertebrates to exchange for Devonian and other fossils.

Botany. 1500 specimens: general flora of Connecticut.

Ethnology. 75 specimens: Indian implements.

Peabody museum of natural history, Yale university, New Haven. Charles E. Beecher, *curator in geology and paleontology*; Addison E. Verrill, *zoology*; Edward S. Dana, *mineralogy*; George F. Eaton, *osteology*.

Paleontology. The very extensive invertebrate collections are arranged zoologically. There are some fine, large slabs containing fossils, on exhibition; also type collections showing the development, structure and classification of trilobites and brachiopods.

The vertebrate possessions include many of the finest specimens ever collected: collections made by Prof. Marsh, of vertebrate fossils from the Rocky mountain region and other parts of the west; specimens of toothed birds, mainly *Hesperornis* and

Ichthyornis, discovered by Prof. Marsh in the Cretaceous rocks of Kansas; specimens of the Miocene Brontotheridae from Dakota and Nebraska; remains of Dinocerata from the Eocene of Wyoming; two skeletons of the gigantic moa from New Zealand; a mounted skeleton of a large Cretaceous dinosaur, *Clasaurus*; remains of *Atlantosaurus*, the largest of known land animals; the mounted pelvis and hind limbs of *Brontosaurus*, and a skull of *Triceratops* from the Cretaceous of Wyoming.

Mineralogy. The Gibbs collection, deposited by Col. George Gibbs; private cabinet of Prof. Brush, for study and investigation only and not for general exhibition; one of the largest collections of meteorites in the country, containing the famous mass of meteoric iron weighing 1635 pounds from Texas, some hundreds of large and small meteorites from a single fall in Iowa in May 1879, the interesting Weston meteorite which fell in Weston in 1807, and nearly 1000 meteorites from the great meteoric fall of May 2, 1890, in Winnebago county, Ia.; the large and beautiful collection of Chinese artistic work in stone, chiefly in jade and agates, bequeathed by Dr S. Wells Williams.

Historic and economic geology. Collections in laboratories for use of students.

Zoology. One of the most complete collections of corals in the country; a collection of marine invertebrates from New England; shells and corals from the Pacific coast of America, corals of Bermuda, and shells of Florida, etc.; models of two of the huge cephalopods of the world, one an octopus and the other a species from the Newfoundland seas, related to the squids; skeletons deposited by Prof. Marsh and a nearly complete series of the vertebrate species of New England are on exhibition.

Archeology and ethnology. Collections occupy the fourth floor of the museum.

Scientific association of Meriden, Meriden. Charles H. Stanley Davis, *corresponding secretary*; Willis J. Prouty, *curator*.

Collections not extensive. The late Prof. J. H. Chapin, of St Lawrence university, presented his collection of 2000 minerals to the association.

Geology. 1200 specimens, a portion of which are in the high school.

Trinity college museum, Hartford. Charles Lincoln Edwards in charge; Karl Wilhelm Genthe, *instructor in natural history*.

Paleontology. Typical fossils, originals and casts; among the latter are Ichthyosaurus, Plesiosaurus, Mastodon, Dinotherium, Glyptodon, Megatherium and about 60 Ammonites.

Mineralogy. Type minerals, specially from New York and New England, also many European specimens.

Historic and economic geology and lithology. Models and photographs of volcanic and other important mountains; collections illustrating Vesuvian minerals and rocks and the Triassic formations of Connecticut; Ward collection illustrating the New York system of rocks; Ward stratigraphic collection, and Ward systematic collection of rocks (college series).

Zoology. Skeletons of mammals, birds nests and eggs, shells and corals; Blaschka glass models of Hydrozoa; Ziegler's wax models showing development of the frog and chick.

Botany. Herbarium of Nebraska plants.

Ethnology and anthropology. War clubs, arrowheads, pipes, dresses, pottery, etc., and material, including a skeleton, from the Santa Catalina islands.

Wesleyan university, Middletown. B. P. Raymond, *president*, in charge, assisted by W. N. Rice, *professor of geology*, H. W. Conn, *professor of biology*, and S. W. Loper, *curator*.

Paleontology. 15,000 specimens: including Lower Silurian fossils from Cañon City, Colorado, and Valcour island, Lake Champlain; Subcarboniferous fossils from Chattanooga Tenn., and Crawfordsville Ind.; a fine representation of Triassic fishes, and some fossil footprints of dinosaurs, etc. from the shales and sandstones of the Connecticut valley; lithographic limestone fossils from Solenhofen; a fine representation of Tertiary plants, insects, and fishes from Fossil Wy. and Florissant Col.; many casts of fossils made by Ward and others.

Duplicates of Triassic fishes from the Connecticut valley, and fossils from Cañon City Col. and Fossil Wy. for exchange.

Mineralogy. 13,000 specimens: fine material from both American and European localities; rich in minerals from Middletown, Portland, Haddam, and Chatham Ct.

Duplicates of Connecticut minerals for exchange, specially those from vicinity of Middletown.

Lithology. Collections general, with special exhibits of New Hampshire rocks and of the United States geological survey educational series.

Dynamic geology. Characteristic specimens showing the work of atmospheric, aqueous, organic and igneous agencies.

Zoology. 110,000 specimens: vertebrates of the United States; birds of the United States, marine invertebrates of the Atlantic coast; a large collection of molluscan shells, obtained chiefly by the purchase of the collection of Simeon Shurtleff M. D.; smaller collections of South American birds and Australian mammals. Duplicate shells for exchange.

Botany. 12,000 specimens: herbarium of 5000 species, including some of the collections of Joseph Baratt M. D.; specimens of woods, alcoholic specimens of fungi, etc.

Ethnology. 8000 specimens: relics of the North American Indians; weapons, implements, etc. from the South Sea islands; Chinese objects, most of which were collected by the Rev. M. L. Taft D. D., president of the college at Pekin; 3000 coins, exclusive of duplicates, among which is a large series of Chinese coins, many of which are ancient and rare, presented by Dr Taft.

DELAWARE

Delaware college, Newark. W. H. Bishop, *professor of agriculture and botany*, in charge also of *zoology*; T. R. Wolf, *professor of chemistry, geology and mineralogy*, in charge also of *paleontology*.

Collections general in character.

Paleontology. 250 specimens.

Mineralogy. 600 specimens.

Economic and historic geology. 300 specimens.

Zoology. 200 specimens, mostly invertebrates from the national museum.

Botany. 1000 specimens.

Society of natural history of Delaware, Wilmington. Mrs Ghertein Yeatman, Kennett Square Pa., *corresponding secretary*.

Paleontology. No collection.

Mineralogy. 1500 specimens, part of which are lent to the society, which, however, owns a fairly representative collection of Delaware minerals.

No duplicates for exchange; though Fred J. Hilbiber will exchange Delaware minerals for the benefit of the society.

Economic geology and lithology. Collections small.

Zoology. 400 specimens of the birds of New Castle county and a fine collection of Delaware moths and butterflies.

Frank Morton Jones will exchange.

Botany. 50,000 specimens: well made herbarium of about 11,500 species, generally from the United States and northward, but including forms from Mexico, West Indies and Europe, carefully prepared and arranged for use of students; a local herbarium called the "Edward Tatnall herbarium of New Castle county"; collection of diatoms, made by the late Christian Febiger.

No exchange material; but William M. Canby, Edward Tatnall, and J. T. Pennypacker will exchange for the benefit of the society.

Ethnology. Collections small.

State college for colored students, Dover. W. C. Jason, *president*. Collections small.

DISTRICT OF COLUMBIA

Catholic university of America, Washington. Edward L. Greene, *professor of botany*.

Botany. Between 30,000 and 40,000 specimens: the most complete collection extant of Rocky mountain and Pacific coast vegetation, gathered by Prof. Greene during 25 years of residence and travel, containing types of some hundreds of new species described by him since 1880; a nearly complete herbarium

of eastern and southern botany, with much material from Mexico, South America and Europe.

Duplicates of eastern and far western plants for exchange.

Columbian university, Washington. Howard L. Hodgkins, *dean*.

Small collections for teaching purposes and laboratory use.

Geology, ornithology, botany. Working collections.

Georgetown university, **Coleman museum**, Georgetown. George A. Fargis in charge.

Paleontology. 1500 specimens: invertebrates of the Upper and Lower Silurian and Jurassic formations; Tertiary fossils, specially those from the formations along the Potomac and Chesapeake rivers, and several fine specimens of tusks of the mammoth from Alaska.

Mineralogy. 4000 specimens: minerals from Mt Vesuvius; series of silicates; also a very complete separate collection of minerals from the District of Columbia.

Historic geology. 1100 specimens: a complete and carefully selected representation of rocks of all geologic periods.

Zoology. 10,000 specimens: mammals; birds and birds eggs; reptiles; batrachians; a collection of 200 fishes representing 50 different species; insects; crustaceans; mollusks; echinoderms, and a collection of corals and shells from Manila.

Botany. A very complete series of the woods, and representatives of the marine algae, mosses, ferns and phanerogams of the District of Columbia.

Ethnology and archeology. A very complete series of the Indian remains found in and around the District of Columbia; a fine collection of Alaskan curios, illustrating the dress and customs of the natives; a complete series of papal medals from Martin 5 to Leo 13 (1893); a large collection of ancient and modern coins; and some Chinese and Spanish weapons.

Howard university natural history museum, Washington. W. P. Hay, *professor of natural history*.

Paleontology. 500 specimens: mostly hand specimens for class use including Dakota fossil leaves, Paleozoic shells, and a few Tertiary vertebrates and mollusks.

Mineralogy. 800 specimens: best representative of Washington and vicinity; all specimens reserved for class use.

Zoology. 750 specimens: a few mounted birds; a good series of skeletons, many invertebrates in fluid and dry; and 300 microscope slides of Foraminifera, parts of insects, etc.

Botany. 2000 specimens: flora of the District of Columbia; a working collection of exogens; and 200 sections of trees.

Ethnology. A few Indian implements and some war relics.

United States national museum, Washington. Scientific and administrative staff: Samuel P. Langley, *secretary of the Smithsonian institution, keeper ex officio*; Richard Rathbun, *assistant secretary of the Smithsonian institution*, in charge of the United States national museum; W. de C. Ravenel, *administrative assistant*.

Scientific staff

Department of anthropology: W. H. Holmes, *head curator*.

1 Division of ethnology: O. T. Mason, *curator*; Walter Hough, *assistant curator*; J. W. Fewkes, *collaborator*.

2 Division of historic archeology: Paul Haupt, *honorary curator*; Cyrus Adler, *honorary assistant curator*; I. M. Casanowicz, *aid*.

3 Division of prehistoric archeology

4 Division of technology (mechanical phases): J. E. Watkins, *curator*; George C. Maynard, *aid*.

Section of electricity: G. C. Maynard, *custodian*.

5 Division of graphic arts:

Section of photography: T. W. Smillie, *custodian*.

6 Division of medicine: J. M. Flint, *honorary curator*.

7 Division of religions:

Section of historic religious ceremonials: Cyrus Adler, *custodian*.

8 Division of history and biography:

Section of American history: A. H. Clark, *custodian*; Paul Beckwith, *aid*.

Department of biology: Frederick W. True, *head curator*.

1 Division of mammals: Frederick W. True, *acting curator*; G. S. Miller jr, *assistant curator*; Marcus W. Lyon jr, *aid*.

- 2 Division of birds: Robert Ridgway, *curator*; Charles W. Richmond, *assistant curator*; J. H. Riley, *aid*.

Section of birds eggs: William L. Ralph, *honorary curator*.

- 3 Division of reptiles and batrachians: Leonhard Stejneger, *curator*.

- 4 Division of fishes: Tarleton H. Bean, *honorary curator*; Barton A. Bean, *assistant curator*.

- 5 Division of mollusks: William H. Dall, *honorary curator*; C. T. Simpson, Paul Bartsch, *aids*.

- 6 Division of insects: L. O. Howard, *honorary curator*; W. H. Ashmead, *assistant curator*; R. P. Currie, *aid*.

Section of Hymenoptera: W. H. Ashmead, in charge.

Section of Myriapoda: O. F. Cook, *custodian*.

Section of Diptera: D. W. Coquillett, *custodian*.

Section of Coleoptera: E. A. Schwarz, *custodian*.

Section of Lepidoptera: Harrison G. Dyar, *custodian*.

Section of Arachnida: Nathan Banks, *custodian*.

- 7 Division of marine invertebrates: Richard Rathbun, *honorary curator*; J. E. Benedict, *first assistant curator*; M. J. Rathbun, *second assistant curator*; Harriet Richardson, *collaborator*.

Section of helminthologic collections: C. W. Stiles, *custodian*.

- 8 Division of comparative anatomy: Frederick A. Lucas, *curator*.

- 9 Division of plants (national herbarium): Frederick V. Coville, *honorary curator*; J. N. Rose, C. L. Pollard, *assistant curators*; W. R. Maxon, *aid*.

Section of forestry: B. E. Fernow, *honorary curator*.

Section of cryptogamic collections: O. F. Cook, *honorary assistant curator*.

Section of algae: W. T. Swingle, *custodian*.

Section of lower fungi: D. G. Fairchild, *custodian*.

Associates in zoology (*honorary*): Theodore N. Gill, C. Hart Merriam, R. E. C. Sterns.

Department of geology: George P. Merrill, *head curator*.

1 Division of physical and chemical geology (systematic and applied): George P. Merrill, *curator*; W. H. Newhall, *aid*.

2 Division of mineralogy: F. W. Clarke, *honorary curator*; Wirt Tassin, *assistant curator*; L. T. Chamberlain, *honorary custodian of gems and precious stones*.

3 Division of stratigraphic paleontology: Charles D. Walcott, *honorary curator*; Charles Schuchert, *assistant curator*.

Section of vertebrate fossils: F. A. Lucas, *acting curator*.

Section of invertebrate fossils: Paleozoic, Charles Schuchert, *custodian*; Carboniferous, George H. Girty, *custodian*; Mesozoic, T. W. Stanton, *custodian*; Cenozoic, W. H. Dall, *associate curator*.

Section of paleobotany: Lester F. Ward, *associate curator*; A. C. Peale, *aid*; F. H. Knowlton, *custodian of Mesozoic plants*; David White, *custodian of Paleozoic plants*.

Administrative staff

Associate in paleontology (honorary): Charles A. White.

Administrative assistant, William deC. Ravenel; *superintendent* J. E. Watkins; *chief of correspondence and documents*, R. I. Geare; *photographer*, T. W. Smillie; *registrar*, S. C. Brown; *disbursing clerk*, W. W. Karr; *supervisor of construction*, J. S. Goldsmith; *property clerk*, W. A. Knowles (acting); *librarian*, Cyrus Adler; *assistant librarian*, N. P. Scudder; *editor*, Marcus Benjamin.

Paleontology. 376,721 specimens, including much material described in the various government geological surveys; 58,000 types and illustrated specimens; fossil plants from all horizons, invertebrates from the Cambrian, Ordovician, Carboniferous, Upper Cretaceous and Tertiary deposits.

Mineralogy. 29,527 specimens arranged in three general series; exhibition, study and duplicates. The exhibition series, intended for the public and the student, is arranged under the following heads: systematic series; comparative series; meteorite collection; gem collection.

The systematic series is divided into two general classes: native elements and compounds of the elements. The compounds of the elements are further divided and grouped under certain heads according to their more negative constituents, as follows:

Compounds of the halogens, fluorids, chlorids, bromids and iodids. Compounds of sulfur, selenium, tellurium, arsenic, and antimony, including sulfids, selenids and tellurids, arsenids, antimonids, sulfarsenids and sulfantimonids; also sulfosalts. Oxygen compounds, including oxids and the oxygen salts, borates, aluminates, chromites, ferrites, manganites, plumbates, arsenites and antimonites, selenites and tellurites, carbonates, silicates, titanates, columbates and tantalates, nitrates, vanadates, phosphates, arsenates and antimonates, sulfates, selenates and tellurates, chromates, molybdates and tungstates, iodates and uranates. Compounds of organic origin, including salts of organic acids and carbon compounds.

Each of these classes is further separated into groups according to their chemical relationships. Each group is preceded by a general group label stating the class to which it belongs, the group name, a list of the minerals composing that group, together with their chemical formulas, system of crystallization, and a short description of the occurrence, association, and characteristic form of each member of the group. Following the group label, arranged in order from left to right, are the several members of the group selected to illustrate, as completely as the conditions will permit, their occurrences, associations, color, habit, etc.

Each specimen is mounted on a standard block, in front of which is a small label giving the name, locality, etc. of the individual.

In the comparative series the properties of minerals are defined, illustrated and compared. In each case the label containing a definition of the property under consideration precedes a series of specimens and, wherever they can be used advantageously, a series of models illustrating that property.

The meteorite collection, including the Shepard and museum collections, now contains several hundred specimens representing 336 falls. As in the other series, the collections are preceded by introductory labels, on which are noted the more prominent physical and chemical characters of meteorites, together with the classification here adopted. The arrangement of the two collections is somewhat different, that of the museum being geographic, while the Shepard collection is chronologic.

The gem collection now compares favorably with any other public collection of this kind in the country, both in number and kinds of stones exhibited. It is specially rich in those gems and ornamental stones which occur in the United States.

The study series includes material appealing exclusively to the specialist and is the source from which new exhibition series may be built, or old ones strengthened. It contains all that material which has been the source of investigation, or may be made the subject of research; together with those specimens, illustrating the occurrence and associations of a mineral in any one locality, that are not needed in the exhibition series, or which are not unnecessary duplications of the material already on hand. It also contains all original or type material belonging to the department. This is brought together in a case of drawers reserved for that purpose, and all type or original specimens which are not needed to complete the exhibition series are placed here together with a copy or abstract of the original papers, and a bibliography of publication in which the work has appeared. Those types used in the exhibition series are here indicated by cards giving their exact position in the cases.

The duplicate series includes all material not needed for the exhibition or study series, and from it all exchanges, gifts, etc., are made up.

Historic and economic geology and lithology. Four distinct series of specimens: exhibition series, 23,097 specimens; study series, 28,911; microscopic slides, 4700; duplicate series, 77,863 of all kinds.

Zoology. 2,661,148 specimens: mammals 27,016, birds 115,059, birds eggs and nests 64,661, insects 994,236, reptiles and batrachians 38,977, fishes 151,301, marine invertebrates 509,331, mollusks 740,017, helminthologic collection (catalogue entries) 4945, comparative anatomy 15,585.

Many duplicates for exchange.

Botany. 391,241 specimens from all parts of the world. Many duplicates available for exchange.

Anthropology. 818,234 specimens.

The national museum makes exchanges in all departments, and also makes up extensive collections from the duplicate material, specially conchological and geologic, which are presented to educational institutions throughout the country.

FLORIDA

John B. Stetson university, De Land. John F. Forbes, *president*. Collections small, consisting of about 2500 specimens of geologic, mineralogic and zoologic material.

GEORGIA

Bowdon college, Bowdon. No report.

Emory college, Oxford. H. H. Stone, *curator*.

Paleontology. 200 specimens from the Silurian, Carboniferous, Cretaceous and Tertiary.

Mineralogy. 5000 specimens including Smithsonian collections and miscellaneous specimens from Georgia, Maryland, New York, Italy, Sicily and Africa.

Historic and economic geology and lithology. A few specimens.

Zoology. A very limited collection.

The museum is made up largely of Japanese, Chinese and Indian curios together with relics of Civil and Spanish American Wars.

Geological survey of Georgia (state museum), state capitol, Atlanta. W. S. Yeates, *state geologist and curator of the museum*; S. W. McCallie and Thomas L. Watson, *assistant geologists*. Mr McCallie is also assistant curator of the museum in charge of the biologic departments.

Mineralogy. 930 specimens arranged in systematic series.

Economic geology. 149 specimens of Georgia ores, clays, abrasives, etc.; 50 eight inch cubes of building stones including marble, granite, gneiss, hornblende, sandstone, serpentine and Caen stone, from various localities in the state, uniformly dressed to show susceptibility to various methods of finishing. A series of six slabs of marble, white, mottled, pink and gray, from the quarries of the Georgia marble co., at Tate; a pyramid of large lumps of pyrite from Lumpkin county; and a few large specimens of ores of gold, iron and manganese.

Zoology. Collections small.

Botany. 147 specimens of Georgia woods, cut and polished; 236 bottles containing specimens of fruit; an imperfect series of cotton from plant to spindle.

Material exhibited by Georgia at the Cotton states and international exposition, including besides that above mentioned, a relief map of that part of Georgia surveyed by the United States geological survey; 282 specimens of mineral waters; photographic transparencies of Georgia scenery; and 203 Indian relics.

Total, 3352 catalogued specimens.

Mercer university, Macon. J. F. Sellers, *professor of geology*, in charge. G. W. Macon, *professor of biology*.

Paleontology. Willett collection of about 1000 specimens of Mesozoic invertebrate fossils, chiefly Cretaceous; Tolafree collection of about 500 specimens of Paleozoic invertebrate fossils, chiefly Devonian; about 300 specimens of Paleozoic invertebrate fossils, chiefly Silurian; about 200 specimens of Mesozoic vertebrate fossils consisting of fish teeth and vertebrae from the Cretaceous of southwestern and middle Alabama; miscellaneous collection of about 500 invertebrate fossils, Paleozoic, Mesozoic and Tertiary. Total number of specimens 2500. This museum has for exchange about 250 invertebrate Cretaceous fossils.

Mineralogy. Mercer collection of about 1000 rocks, chiefly from United States; Shepard collection of about 1200 minerals from various localities; J. Lawrence Smith collection of about

500 minerals and rocks from various localities; Smithsonian collection of about 1000 minerals and rocks from various localities; Georgia collection of about 500 minerals and rocks from Georgia; miscellaneous collection of about 1000 minerals and rocks chiefly from Georgia. Total number of specimens about 5000. The museum has for exchange about 500 specimens of Georgia minerals and rocks.

Historic and economic geology and lithology. About 1000 specimens of Georgia iron, gold, graphite, asbestos, ochre and bauxite ores; building stones, kaolin, etc.

Zoology. Numerous vertebrate skeletons and parts; a few vertebrate embryos; 50 specimens of Amphioxus, fishes, snakes, turtles and lizards; about 200 specimens of invertebrates; about 100 microscope slides; about 200 specimens of birds eggs. Total number of specimens about 600.

Botany. About 200 dry specimens of gymnosperms and angiosperms; about 50 specimens of thallophyta; about 50 specimens of bryophyta and pteridophyta; a small collection of seeds and fruits; about 200 microscope slides. Total number of specimens 600.

Ethnology and anthropology. 500 specimens, consisting of Indian pottery, rough and polished stone, war utensils, etc.

A small collection of meteorites, consisting of the Stewart Co. (Ga.) stone, the Putnam Co. (Ga.) stone (both described in the *American journal of science*), and several smaller fragments obtained by collection and exchange.

University of Georgia, Athens. Small collections in geology and archeology.

IDAHO

University of Idaho, Moscow. J. M. Aldrich, *curator*.

Paleontology. 250 specimens.

Mineralogy. 1000 specimens.

Historic geology and lithology. Small collection.

Zoology. 40 specimens of mammals; 125 mounted specimens of birds; 80 specimens of fishes; 25 specimens batrachians and reptiles.

Entomology. 16,000 specimens, many unnamed, though about 2000 species have been determined by authorities of high standing.

Botany. More than 10,000 sheets of flowering plants; also collections of woods, tree fruits, fungi, etc.

Archeology. 100 specimens; also some arrowheads and minor articles.

ILLINOIS

Augustana college, Rock Island. J. A. Udden, *curator*. The museum is intended as an adjunct in instruction, but is also devoted to the care of local natural history material.

Paleontology. 4000 specimens: general collection; McMaster collection from Rock Island and vicinity.

Mineralogy. 500 specimens: general.

Historic and economic geology and lithology. 1000 specimens: rocks, 500; formational collection of rocks and some fossils, 300; collection illustrating dynamic geology, folds, mud cracks, concretions, etc., 200.

Zoology. 3000 specimens: 2000 general; egg collection, 100 species.

Botany. 3000 specimens: exsiccate phanerogams.

Ethnology and anthropology. 1000 specimens: 500 coins; Kaffir articles of ornament, etc.; Hindu workmanship; American Indian relics.

Austin college, Effingham. No report.

Carthage college, Carthage. No report.

Chicago academy of sciences, Lincoln park, Chicago. Thomas C. Chamberlin, *president*; William K. Higley, *secretary*; Frank C. Baker, *curator in charge*; Frank M. Woodruff, *taxidermist*.

Paleontology. 12,000 specimens representing 1600 species of fossils: specially rich in forms of Silurian and Carboniferous formations; nearly complete collection of Niagara fossils from Chicago region containing about 30 type specimens; a mounted skeleton of *Elephas primigenius* and a good specimen of a skull of *Castoroides ohioensis*. The Cincinnati

collection includes several type specimens of Miller's cephalopods (Endoceras).

The type specimens exhibited are: *Endoceras egani*, *bristolense*, and *inaequabile*; *Eucalyptocrinus egani*, *rotundus*, *depressus*, and *turbinatus*; *Saccocrinus infelix*, *pyriformis*, and *urniformis*; *Glyptaster egani*; *Cyathocrinus vanhorni*; *Myelodactylus bridgeportensis*; *Cleidophorus chicagoensis*; *Holocystites jolietensis*; and *Strotocrinus bloomfieldensis*, described by S. A. Miller; redescribed types: *Saccocrinus marcouanus* Winchell and Marcy; *Cyathocrinus cora* Hall; *Ichthyocrinus corbis* Winchell and Marcy, and *Melocrinus obpyramidalis*, Winchell and Marcy; *Cyathocrinus turbinatus*, *Ampheristocrinus dubius*, *Cyphocrinus chicagoensis* and *Rhyncosaccus americanus* are all Weller's types. Many duplicates for exchange.

Mineralogy. 350 species and varieties and 3500 specimens of world-wide distribution, but particularly representing the United States. Quartz, calcite, gypsum, feldspar, copper carbonates, and the sulfids are the best represented groups. A few duplicates for exchange.

Historic geology. Collections illustrate all formations, but principally the Hudson river group, the Niagara of the Chicago region, the Burlington, the Mazon creek Carboniferous, and the Tertiary of the southeastern United States.

Lithology. 1000 specimens: illustrating the principal geologic periods, also all minerals useful to man; numerous original models of phenomena in dynamic geology. Some material for exchange.

Zoology. 100,000 specimens illustrating the fauna of the United States. Protozoa represented by colored figures; a small series of Porifera, Coelenterata, Echinodermata and Vermes; 4000 species and 75,000 specimens of Mollusca, including 150 species, 5000 specimens comprising a complete collection of the local

fauna, represented by specimens of all ages and varieties including several types; 6000 species, 20,000 specimens of North American Insecta besides good collections of Arachnida and Crustacea; a series of American Reptilia and Batrachia; a large collection of birds from North America, including a complete series of the avifauna of the Chicago region; a small series of North American mammals, including several from Alaska (moose, mountain sheep, etc.). Nearly every department contains some type specimens. Material for exchange.

Botany. 5000 specimens: a representative series of local and United States phanerogams and vascular cryptogams, and a large collection (700 species) of lichens. Limited number of flowering plants for exchange.

Ethnology. 1000 specimens: some excellent axes and arrow points of the American Indians from the Central states.

The arrangement of the academy's collections is consecutive, the sequence beginning with mineralogy and continuing through historic geology, zoology and ethnology from the lower to the higher types. A hand indicates the direction of the classification and four of these are placed in each case. Labels are printed in clear type and each case is furnished with explanatory labels giving notes of classes, orders, families, etc., and in addition pictures, maps and models are profusely used where they will in any way add to the understanding of the objects exhibited. A limited number of well selected specimens are exhibited for the public, mounted on heavy binders board tablets, covered with light-faced manila cardboard, which is not seriously affected by light. The study series, where the majority of the specimens are placed, is installed in drawers beneath the exhibition cases, each set in a dark-colored cardboard tray, the data being printed on a small label glued to the tray.

The exhibits of the museum are designed primarily for the instruction of the general public and for this reason each case is made as nearly encyclopedic as possible. The study series is prepared for the student and specialist and is installed with the strictest regard for scientific accuracy, but does not contain descriptive labels of any kind.

Chicago university, Walker museum, Chicago. Thomas C. Chamberlin, *professor of geology and director*. Curators: Rollin D. Salisbury, *professor of geographic geology*; Joseph P. Iddings, *professor of petrology*; Richard A. F. Penrose jr, *professor of economic geology*; Samuel W. Williston, *professor of paleontology*; Frederick Starr, *associate professor of anthropology*; Stuart Weller, *assistant professor of paleontologic geology*; William F. E. Gurley, *associate curator*.

Paleontology. 10,000 catalogued numbers, with 50,000 (estimated) not yet catalogued, 500,000 (estimated) specimens in all; including about 2000 type specimens representing about 1000 species. The most important collections are, the Gurley collection, the James collection, the Faber collection, the Sampson collection, the Washburn collection, the Van Horne collection and the Weller collection. The formations best represented are the Paleozoic of the Mississippi and Ohio valleys.

In vertebrate paleontology, there are nearly 500 catalogued specimens, with a smaller number yet uncatalogued, for the most part collected under the direction of the late Professor Baur, or obtained by purchase. The larger part of these are from the Permian of Texas and Illinois and the Laramie Cretaceous of Wyoming, with others from the White River Oligocene, the Kansas Niobrara Cretaceous and from Europe.

Duplicates for exchange from the Niagara group of Waldron Ind.

Mineralogy. 2000 specimens, best representing the commoner minerals and the tellurids and intended to illustrate chiefly the crystallographic development of minerals.

Economic mineralogy. 3000 specimens covering a wide range.

Lithology. 2500 specimens, embracing igneous, sedimentary and metamorphic rocks, but chiefly the former; and intended to illustrate the whole range of rocks.

Economic geology. A large series of ores and other mining products, representing the leading mining districts of the United States and of many foreign countries.

Geology. A systematic series of fossils arranged on a stratigraphic basis, illustrating the successive faunas and floras.

Zoology and botany. Extensive collections for class use only and therefore not considered as part of the museum.

Ethnology and archeology. 3000 specimens: exhibiting the archeology of several well marked archeologic districts of Mexico; illustrating the food supply, arts and industries of the cliff dwellers of Utah; collections from the Aleutian islands and from Japan, illustrating the ethnology of those regions; articles illustrating the ethnology of the Pueblo Indians of Mexico, and the Swiss lake dwellers; and several loan collections.

Total, 400,000 specimens.

College of liberal arts, Northwestern university, Evanston. U. S. Grant *curator*; A. R. Crook *mineralogy*; C. B. Atwell, *botany*; W. A. Locy *zoology*; and W. A. Phillips *anthropology*.

Paleontology. 3000 fossils from the Subcarboniferous of Illinois; a large number of specimens from the Coal Measures of Illinois; 300 specimens, including several types, from the Niagara group in the vicinity of Chicago; and 1000 specimens from the Cretaceous and Tertiary formations of Alabama.

Mineralogy. Some interesting material from the Lake Superior region; from Hot Springs Ark.; from the Yellowstone national park; and from the Black Hills of South Dakota. Much fine material was obtained from the World's Columbian exposition.

Mineralogy and lithology. 22,000 specimens: including a series of specimens from the typical localities of Europe; a set of rocks of Illinois; a set from the Black Hills of South Dakota; and a set from the Yellowstone national park; a set from the Lake Superior district and the U. S. geological survey educational series of rocks. Also a set of rocks from the copper bearing formation of Lake Superior and ore from the upper Mississippi lead and zinc district; these two sets are the property of the Wisconsin geological and natural history survey.

Zoology. 28,000 specimens: 3000 birds; 700 reptiles and batrachians; 900 fishes and 18,000 shells.

Botany. 20,000 specimens, including the college and Babcock herbariums, and various collections received from the World's Columbian exposition.

Ethnology. 8000 specimens exclusive of the local collection: relics of North American Indians; collections from southern Illinois, Missouri and Kentucky; complete series of specimens from England illustrating the process of making gunflints; and a large variety of material from various parts of the world. Much described material not on exhibition owing to lack of room.

The university medical school has a museum of comparative anatomy at Chicago.

Connected with the museum at Evanston is a "museum of ceramics and other arts".

Elgin scientific society, Elgin. Collections are small, the geologic material consisting principally of specimens gathered in the vicinity of Elgin, with a limited amount from Colorado, California and elsewhere.

The society has also a collection of shells and corals and some curios from Egypt and elsewhere.

Field Columbian museum, Chicago. F. J. V. Skiff, *director*.

Paleontology. 7000 specimens of fossils, with casts and models arranged chronologically to illustrate the animal and vegetable forms which have characterized the life of the globe at the succeeding stages of its history; exceptionally large and complete series of fossils of Niagara age from the Chicago region, of Mazon Creek Coal Measures plants, of European and American ammonites, of European ichthyosaurs, of American dinosaurs and of Bad Lands vertebrates; complete skeletons of the mastodon, Irish deer and extinct moa of New Zealand, and the largest known skull of Titanotherium and largest known limb bones of dinosaur.

Mineralogy. 6000 specimens. The arrangement is based on that given in Dana's new *System of mineralogy*, the purpose being to illustrate the different species therein described. Specimens worthy of special notice are: among the sulfides, large crystals of stibnite from Japan; among the haloids, the beautiful green and purple fluorites from English and American localities; among the oxids, the extensive collection of natural and ar-

tificially colored agates from South America; among the carbonates, curiously distorted calcite crystals from Egremont Eng. and the flos ferri aragonites; among the silicates, large crystals of Amazon stone from Pike's Peak, Col., and the transparent and perfect crystals of topaz from Siberia; among the phosphates, the richly colored vanadinites from Arizona; and among the sulfates, the brilliant groups of celestite from Sicily.

In addition to these the museum contains the Higinbotham collection of gems and gem minerals, one of the most valuable in the world. The Chalmers crystal collection contains about 200 specimens from the United States.

The collection of meteorites includes over 230 "falls" or "finds", represented by 5000 specimens having an aggregate weight of 4745.6 pounds, and 63 casts or models of notable meteorites. The specimens are divided into three classes, viz, siderites, siderolites and aerolites, and are arranged chronologically.

Structural and dynamic geology. 1500 specimens illustrating dendrites, volcanic products, cave products, varieties of rock structure, concretionary structure, and rock texture. A realistic reproduction of a limestone cave, in which about 100 specimens of stalactites and stalagmites are mounted in their natural position and with proper accessories, is an important feature of the exhibit.

Economic geology. 10,000 specimens, probably the largest and most complete of the kind in the world, illustrating modes of occurrence in nature of the minerals and ores of economic importance. Nearly all the important mining districts of the world are represented by typical specimens. Specially complete series are: mineral oils of the United States and their products, coals of the United States, platinum ores, zinc ores of the United States, marbles and clays. Ores of gold, silver, lead, copper, iron, zinc, mercury, nickel, and the rarer metals are also fully illustrated, many of the specimens being of great size and of a high degree of perfection. A full sized statistical column originally prepared by the United States geological survey, illus-

trates the quantity of different mineral products mined in the United States for each second of time during the year 1892. Numerous metallurgic processes are illustrated by specimens and charts.

Geographic geology. 50 relief maps with charts, globes and other geographic material illustrating topography, topography and geology, or topography and culture of various regions of the earth, and an accurate relief map 19 feet in diameter, of the surface of the moon.

Lithology. Two collections: one of rock specimens systematically arranged and one of polished and ornamental stone. The former includes about 1800 specimens of uniform size, 4 x 3 x 1 inches, representing the different kinds of rocks. The latter is made up of about 200 specimens of polished slabs of different sizes, intended to illustrate the different ornamental stones, chiefly marbles and granites.

Zoology. Representatives of all the important classes of animals, with few exceptions arranged in systematic order, beginning with the lowest forms and ending with the highest. The chief groups are: 1) Porifera from the Mediterranean and the West Indies. 2) Coelenterata, in wall cases about 8 feet high and with a total length of 130 feet, from all parts of the world, many of the Actinozoa being represented by glass models. 3) Echinodermata in table cases which have a glass surface of over 300 square feet. 4) A small collection of Annulata. 5) Arthropoda; the crustaceans filling a wall case 8 feet high and 50 feet in length, insects, 10,000 species, most of which are on exhibition, Coleoptera best represented, Lepidoptera coming next with 2000 specimens. 6) Mollusca, about 7000 species, most of which are mounted on tablets and displayed in table cases, presenting an exhibition surface of over 1200 square feet. The Nudibranchia are represented by glass models. The Brachio-poda are installed with the Mollusca. 7) Pisces are represented by 1600 species. A series representing the leading groups are exhibited by means of casts, mounted specimens and alcoholics. 8) Reptilia. About 300 species, some of which are mounted.

The rest are alcoholics. 9) Aves, chiefly the C. B. Cory collection made under Mr Cory's direction in southern United States and the West Indies, a collection from East Africa by the museum's East African expedition and a collection of North American bird skins. About 600 birds are mounted and a few mounted groups beautifully illustrate color protection and other characteristics. There is also a collection of North American and foreign birds eggs. 10) Mammalia comprises over 8000 specimens. A large series representing all orders is mounted and arranged in systematic order, beginning with the duckbill and ending with the chimpanzee. In addition there are 12 real and artistic groups of large mammals, three to eight animals in each, mounted by Mr C. E. Akeley, showing much of their natural history. The valuable osteologic collection consists of mounted skeletons of over 225 species of animals, including, with few exceptions, all the important orders of the Vertebrata, and arranged in systematic order, paralleling the mounted specimens.

Botany. Economic: collections of the foreign governments in forestry, as exhibited in the government and forestry buildings at the World's fair; the major part of the gums, oils, medicinal plants, tan barks, dyewoods, seeds and fibers exhibited by the foreign countries in the agricultural and manufacturers building; the economic plant exhibit of the United States government as displayed in the government building; and portions of many American exhibits in this important branch of natural science. Among the specimens exhibited is a very fine and costly decortication of a cork tree with three branches, considered to be the best example of dexterous bark peeling ever procured. Starting with the above material as a base, material that is unique in its completeness and museum character, other large series representing the source, utilization and character of a large number of vegetable products are being installed. These series begin with the source of each product and carry it through its processes to its completed form for utilization by man.

Systematic collections. The herbarium contains over 150,000 sheets of plants principally from North America, the West Indies and Europe; comprises the former private herbariums of Dr Arthur Schott, notable for its United States boundary survey and Isthmus of Darien survey plants, and his Yucatec and Hungarian series; that of Mr M. S. Bebb, notable for the largest representation of the genus *Salix* in this country; that of Mr Arthur A. Heller and of Mr Harry N. Patterson, notable for its complete representation of the plants of Gray's manual and its full sets of Curtiss, Pringle, Cusick, Chapman, Hall & Harbour, the Gaumer Yucatan plants; the plants of the Allison V. Armour expeditions, etc.; a large number of classic series of the plants of North America, South America, the West Indies and Central America.

Anthropology. Collections are intended mainly to illustrate the more primitive or uncivilized phases of the development of the human race. There are two divisions of the subject, and the collections illustrating them are separately installed. The first division consists of apparatus used in studying the greatly varied physical and psychic phenomena. The second comprises exhibits of the handiwork of man and of collections of crania, casts and other objects, articles and materials illustrating the physical characteristics of the race. The works of prehistoric peoples are brought together in groups according to locality from which they are derived, people, time, or stage of progress they are thought to represent, or, otherwise, with reference to some other special subject to be illustrated. Those of living or historic peoples are assembled according to the tribe or nation to which they pertain.

The physical and psychic anthropologic collection consists of various kinds of apparatus obtained and set in place by Dr Joseph Jastrow, the Boas collection of skulls, trephined skulls from Peru, Papuan skulls, etc.

Ethnology. The more notable collections are: Stanley McCormick Hopi material; Edward E. Ayer collection of North American material; Hassler collection of feather work, and other

ethnologic specimens from the Indians of Paraguay; Bruce collection from Alaska; Welles collection from Venezuela; Quelch collection from British Guiana; Finch collection from New Guinea; Peace collection from New Caledonia; Remenyi collection from South Africa; Pegosky collection from Siberia, and the H. N. Higinbotham collection from Korea.

Archeology. The more notable collections are: Montes and Dorsey Peruvian collection: United States Columbian collection of objects of gold, earthenware and stone; Harris collection of Peruvian antiquities; Riggs collection from the Southern states; Johnson collection of reproduction of Irish antiquities; Allison V. Armour collection of Mexican antiquities; original and reproduction of ancient Italian bronzes; Cyrus H. McCormick collection of Chilian antiquities; Green cliff house collection; Charnay casts from Central America; and Wyman collection of copper implements and relics of stone, and models of Pueblo villages and ancient ruins, with numerous ancient relics and modern utensils from the Pueblo region; also large series of implements, objects and models illustrating the arts of quarrying and mining and the manufacture of stone implements by the aborigines.

Greer college, Hoopeston. No report.

Hedding college, Abingdon. No report.

Illinois state museum of natural history and geological survey of Illinois, Springfield. C. H. Crantz, *curator and state geologist*. The collections constitute the Illinois state museum of natural history.

Paleontology. 5000 species of fossils collected during the geological survey of the state by Prof. A. H. Worthen.

Mineralogy and geology. 2500 specimens from the state.

Zoology. Mammals, birds, nests and eggs, reptiles, fishes and insects.

Illinois Wesleyan university, Powell museum, Bloomington. J. Culver Hartzell, *curator*.

The Powell museum was named in honor of Maj. J. W. Powell, who was the instructor of natural science in the Illinois Wes-

leyan from 1865 to 1868. Maj. Powell made his early Rocky mountain explorations from the Wesleyan, and the museum, which was established in 1852 with 1700 specimens, contains collections made during these trips. There are now about 40,000 labeled specimens accessible to visitors and about 100,000, also labeled, arranged in trays and cases specially for students. The rest of the material is not catalogued and the amount not known. The material has been received from various sources: the Wheeler, Powell, Canadian and state surveys, the United States geological survey, the United States national museum, the Smithsonian institution, private collections and exchanges.

Paleontology. Nearly all formations of North America are represented by exceptionally fine vertebrate and invertebrate fossils, specially the latter; an extensive collection of Illinois fossils; 10 casts of extinct vertebrates; fossil plants from the Silurian, Carboniferous and Cretaceous, particularly the latter two; a large number of well preserved fossil insects from Colorado and Wyoming.

Mineralogy. Nearly all the species and varieties of Dana are represented; a good collection of crystals.

Geology. Series of rocks representing nearly all formations of Europe and North America, and the lithologic characters of the various groups; a large collection of geologic maps; an extended series of photographs of western geologic scenery; a good collection of ores from the western states.

Zoology. 10,000 species of shells from various parts of the world; 1000 species of insects from Europe and America; 600 species of birds mostly from America; 100 clutches of eggs; 200 mammals; 60 skulls of mammals from North America, South America and Australia; a series of human skulls, modern, cliff dwellers and mound builders; several hundred alcoholic specimens.

Botany. 1000 species of marine algae from various parts of the world; 600 species of ferns from North America, Hawaiian islands, India, China, Japan, Australia, New Zealand, South

America and Europe; 500 mosses and lichens from North America and Europe; 6000 species of phanerogams from North and South America, Europe and Australia; a nearly complete collection of North American woods.

Ethnology. A large collection of Zuñi and Moqui utensils, pottery, articles of dress, etc.; a number of vases, masks, sculptured heads etc. from Mexico; utensils of the cliff dwellers and mound builders; a recently acquired collection of 1140 specimens of tablets, pipes, mills, celts, knives, saws, discoids, mortars, etc.; old coins; articles of dress; relics from battlefields, etc.

Knox college, Galesburg. Albert Hurd in charge.

Paleontology. 2100 specimens: a general collection of fossils illustrating all formations, specially the Carboniferous; no type specimens.

Mineralogy. 1250 specimens: general collection illustrating fairly well the common minerals.

Zoology. 17,000 specimens: 400 species of birds; 2500 species of shells, marine, fresh-water and terrestrial; 2000 species of insects, etc. The specimens in nearly all classes and orders are selected mainly for general illustration in zoology.

Botany. 20,000 specimens, 9000 species, including the "Mead herbarium" of Dr S. B. Mead, Augusta Ill., nearly one half of which are foreign. 2100 species, 8000 specimens from the "Mead herbarium," representing a large number of families, for exchange.

Ethnology and anthropology. 100 specimens: 50 Neolithic implements from Denmark, and a few others.

Lake Forest university museum, Lake Forest.

Small collections.

Geology. A good set of the Guelph group of Niagara fossils from the vicinity of Port Byron Ill.; a collection of the Mazon creek (Ill.) ferns; and several smaller ones from various parts of the state.

Lincoln college of the James Millikin university, Lincoln. C. S. Oglevee, *professor of biology*, in charge.

Collections small and not properly classified and catalogued.

Northwestern college, Naperville. L. M. Umbach, *professor of natural sciences*, in charge.

Paleontology. 300 specimens: including Silurian species from Illinois, Iowa and Indiana; many Devonian Mollusca, etc., from Ohio; and good collection of Carboniferous plants from Mazon creek, Grundy co. Ill.

Mineralogy, economic and historic geology, and lithology. The combined collections aggregate about 600 specimens, including rocks from the glacial drift of this region; a series of agatized woods from Colorado; lithologic material from Massachusetts and Connecticut; and an economic collection illustrating the mining regions of northern Wisconsin and Michigan.

Zoology. A small series of local mammals, birds, reptiles, and fishes—about 150 specimens in all.

Botany. 17,000 specimens illustrating about 5000 species of plants: a fair representation of the flora of North America; quite complete herbarium of plants from the vicinity of Chicago; about 350 Yucatan species and a small herbarium of European species.

Exchange list includes 2000 specimens of about 1200 different species.

Ethnology. 350 specimens, including several skeletons, articles of wearing apparel, stone implements, etc.

Taylor museum, Blackburn university, Carlinville. J. D. Conley in charge; Charles Robertson, *assistant*.

Paleontology. 12,000 specimens: representing nearly every epoch throughout the Paleozoic and Mesozoic eras; a large part of the Van Cleve corals figured in the Indiana report; richer in drift corals than anything else but with an equal number of Silurian, Devonian and Carboniferous fossils; a large number of duplicates of the above fossils but comparatively few species in the Jurassic, Cretaceous and Tertiary.

Mineralogy. 5000 specimens: copper and iron ores; volcanic products.

Historic and economic geology and lithology. One of the largest collections in the state consisting of 75 cases averaging 4x5 feet wall space; specimens labeled but not catalogued.

Zoology. A small collection.

Botany. A small collection.

Ethnology and anthropology. 500 specimens: Indian axes; spear and arrowheads; pottery, pestles and ceremonial implements.

University of Illinois, Champaign. The professors of the several departments are in charge of their respective departments of the museum, there being no regular museum curators. C. W. Rolfe, *professor of geology*.

Paleontology. 49,000 specimens: private collection of Prof. A. H. Worthen, ex-state geologist; duplicates from the state museum, of the collection made by the Worthen survey of the state; private collection of the Rev. H. Herzer, of Ohio; private collection of Mr Tyler McWhorter; Ward's series of casts of fossils; special collections obtained by purchase and exchange; and 742 type specimens from the geologic survey of Illinois. The collections are particularly rich in Paleozoic material.

Mineralogy. 12,000 specimens, arranged solely for purposes of class study, no attempt being made to collect showy specimens on account of the limited means available, and 575 crystal models. It includes all but the rarest species.

Historic and economic geology and lithology. 5500 specimens and 1000 thin sections obtained by purchase and illustrating nearly all formations. The economic collection includes a good series of ores, building and ornamental stones, soils and other economic materials.

Zoology. 11,000 specimens, illustrating chiefly the mammals, birds (with nests and eggs), reptiles, fishes and casts of fishes and mollusks. The Bolter collection of insects contains over 16,000 species represented by about 120,000 specimens. The lower invertebrates are represented in part by a large series of Blaschka glass models. The extensive collections of the Illinois state laboratory of natural history are also available to the university students. No duplicates for exchange.

Botany. 40,000 specimens: students reference herbarium, confined to the flora of this, Champaign, county; experiment station herbarium, consisting chiefly of weeds, specimens illustrating diseases of cultivated plants, cultivated plants, and plant seeds; a museum collection of the woods of Illinois; and the university herbarium, which makes a specialty of the flora of Illinois. The collections are specially rich in certain groups of fungi and in the exsiccati of fungi. Duplicate specimens for exchange.

Ethnology and anthropology. 800 specimens: including arrow points, spearheads, etc., mostly from the bluffs of the Mississippi river in Calhoun county, Ill., and vicinity, Indian tools and household utensils, casts of skulls and brains, and models of the cliff dwellings of the southwest. No duplicates for exchange.

Wheaton college, Wheaton. No report.

INDIANA

Franklin college, Gorbey collection, Franklin. D. A. Owen in charge.

Paleontology. 35,000 specimens best representing formations of the Silurian, Devonian and Carboniferous systems, the specimens consisting of corals, crinoids, brachiopods, lamellibranchs, gastropods, cephalopods, trilobites and a few vertebrates.

Mineralogy. About 1000 specimens collected in various parts of the United States, with some from other countries.

Zoology. 200 specimens of birds, and 750 birds eggs; 500 mollusks.

Ethnology. 300 specimens of arrowheads, axes, and other relics of the American Indians and 300 specimens of the cliff dwellers.

Hanover college museum, Hanover. Glenn Culbertson, *professor of geology*.

Geology. A working collection of 500 specimens, many of which are excellent of their kind, obtained to a great extent from the formations near Hanover and including a good series of fossils from the Hudson river group; many from the Clinton group; a large collection of Niagara, Corniferous and other Devonian

fossils; a few from the Carboniferous system; a number of Jurassic and Cretaceous and some bones and teeth of Mastodon and Elephas.

Indiana university museum, Bloomington. C. H. Eigenmann, *professor of zoology* in charge; V. F. Masters, *professor of geology*; D. M. Mottier, *professor of botany*.

Paleontology. 10,000 specimens: very complete collection of corals from Falls of the Ohio; fair collection of Brachiopoda; many thousand fossils of the Cincinnati group; numerous specimens of all the species of the Spergen hill fauna; nearly complete representation of the Waldron fauna; small series from the Genesee, Hamilton and Portage of New York; small series from the New York Trenton.

Cincinnati, Waldron and Spergen hill species for exchange.

Mineralogy. 250 species: ores and rock-making minerals constituting a working collection for students.

Historic and economic geology and lithology. Series of rocks illustrating the geologic formations of the United States; series (United States geological survey) illustrating the lithologic types.

Zoology. 55,000 specimens: several thousand species of fishes; several hundred birds; limited number of mammals, reptiles and batrachians; miscellaneous collection of invertebrates.

Botany. A small but constantly increasing collection of dry and alcoholic specimens of the higher and lower forms of plant life illustrating certain phases.

Purdue university, Lafayette. Stanley Coulter, *director of the biologic laboratories*.

Paleontology. 4000 specimens, confined almost exclusively to the forms found in the Indiana series of rocks. While there are no type specimens, the collections are fairly complete in Silurian, Devonian and Carboniferous forms.

Mineralogy. A representative series of 1000 specimens of general interest. No duplicates for exchange.

Economic geology and lithology. Material is included in other collections, or distributed in the testing laboratories. No duplicates for exchange.

Zoology. 13,000 specimens: an almost complete series of mammals and birds of Indiana, numbering 500 specimens; the A. W. Butler collection of the lower vertebrates of Indiana, giving full suites of the serpents, lizards and batrachians; 500 fishes, representative of the larger genera and families; the Scheuch collection of Coleoptera, 6000 specimens; and the Scheuch and other collections of mollusks, 6000. No material for exchange.

Botany. 8000 specimens: 5000 phanerogams; 2000 cryptogams, etc.; 500 specimens of seeds and economic products; 60 of wood, and 500 microscopic sections. No material for exchange.

Ethnology. 1000 specimens: small collections of relics from Fort Ouiatenon and from the Pueblo Indian villages; also collection of local stone implements. No exchange.

The museum is organized for illustrative purposes in the various branches of science, and other features are subordinate to this.

Taylor university, Walker museum, Upland. O. W. Brackney, *curator*.

Paleontology. 500 specimens.

Mineralogy. 1000 specimens: iron ores best represented.

Zoology. 100 specimens: mounted birds and animals.

Botany. Mounted plants and specimens of wood found in this vicinity.

Ethnology and anthropology. 300 specimens: Indian relics, etc.

Museum also possesses a collection of coins and stamps.

Wabash college, Hovey museum, Crawfordsville. Mason B. Thomas, *curator*; Donaldson Bodine, *professor of geology and zoology*.

Paleontology. 4300 specimens: 300 casts of fossil vertebrates; 300 fossils from the Coal Measures; 500 crinoids, 200 trilobites and 3000 corals, brachiopods, gastropods, cephalopods, etc. from the Keokuk group at Crawfordsville; fossil fishes from Persia; and a series of mammalian fossils from California.

The illustrative material is valuable and fairly representative. The series of fossils is carefully arranged to portray the development of life from the early primordial times to the present.

Some groups of Devonian and sub-Carboniferous forms are well represented, and have furnished types for various species of crinoids, etc., for which the beds in the near vicinity are famous.

Mineralogy. 4000 specimens, and fairly representative, being specially rich in ores and rare species, and including an extensive study collection.

The economic collection includes 400 specimens: a valuable series of marbles and granites, and a series of iron ores with their furnace products, slags, etc.

Zoology. 10,575 specimens: birds 100, reptiles and amphibians 225, fishes 500, crustaceans 100, mollusks 9000, corals 300, sponges and echinoderms 300.

The collection of shells arranged and classified for systematic work, offers unusual facilities for students and includes many very rare species.

Zoological materials are arranged systematically to illustrate the development of the animal kingdom. The series of invertebrates is very complete, and the vertebrates include many articulated skeletons, and dissected specimens illustrating important anatomic structures.

Botany. A herbarium specially complete in North American species, and containing much material from European, Asiatic and South American countries, of 30,000 phanerogams, and 1500 cryptogams, and a series of 1000 specimens of economic products.

Material used to illustrate lectures in general botany greatly increases the value of these collections. Some parasitic fungi for exchange.

Ethnology. 6000 specimens: relics of the American Indians and the Mound Builders, including arrowheads, weapons, pipes, plummets, drills, ornaments, pottery, fabrics and skulls. Duplicates for exchange.

INDIAN TERRITORY

Indian university, Bacone. J. H. Scott, *president*.

Geology. Collections small and of general distribution, including fossils from the New York and Indian territory formations;

some miscellaneous material; a collection of minerals, including ores, calcites, agates and petrifications.

There is a small collection of fresh-water shells.

IOWA

Amity college museum, College Springs. George M. Reed, *curator* in charge.

Paleontology. 2000 specimens: 1000 mollusks; 50 crinoids; 50 petrified fragments of bones of mountain lions and bears; 50 fragments of fossil lepidodendrons and ferns of Carboniferous age; and 10 belemnites from the Black Hills of Dakota. 200 duplicate mollusks for exchange.

Mineralogy. 1000 specimens of a general nature representing ores of gold, silver, lead, zinc, particularly iron and copper; a good collection of anthracite and bituminous coals from various localities; collections of sedimentary and crystalline rocks.

Zoology. 500 specimens: 200 alcoholic specimens of marine invertebrates; 200 shells; and 50 miscellaneous land specimens.

Botany. 100 specimens of dried plants, seeds and abnormal growths; a series of cotton plants in various stages of growth.

Ethnology. 200 relics of the American Indians; a "prehistoric whetstone" from Kentucky; a few archeologic specimens from the island of Cyprus.

Cornell college, Mount Vernon. No report.

Davenport academy of sciences, Davenport. Mrs Mary L. D. Putnam, *president*; J. H. Paarmann, *curator*.

The academy possesses extensive collections in archeology, ethnology, mineralogy, paleontology, entomology, birds and corals, besides a very large scientific library.

Iowa college, Parker museum of natural history, Grinnell. Director H. W. Norris, *professor of biology and geology* in charge.

Paleontology. 2000 specimens, chiefly from the Silurian and Devonian systems but not at present well arranged.

Mineralogy. A general collection of about 1000 specimens. Duplicates for exchange.

Lithology. Material not abundant.

Zoology. 2000 to 3000 specimens representing all classes of the animal kingdom. Illustrative, rather than comprehensive, with a separate collection of mollusks.

Botany. 2000 mounted specimens of phanerogams and 500 unmounted, and 500 to 1000 cryptogams, illustrating North American and European (chiefly Alpine) forms; small collections from Australia and from St Thomas, West Indies. A large number of European species for exchange.

Ethnology. Collections small.

Muscatine academy of science, Muscatine. R. W. Leverich, *president*.

The academy formerly possessed a valuable geologic collection and library which was totally destroyed by fire in 1896. Collections are being renewed, and now include a few fossils from the Devonian and Carboniferous systems, and from local formations; minerals and ores from Colorado, Arizona and Mexico; about 250 specimens in all. A large number of government publications have been received.

State university of Iowa, Iowa City. C. C. Nutting, *professor of zoology* in charge, assisted by H. F. Wickham, *assistant professor of zoology*, Rudolph Anderson, *taxidermist* and W. B. Bell, *scholar in zoology*.

Paleontology and geology. 30,000 specimens: Iowa fossils and other geologic material.

Zoology. 100,000 specimens, named in order of comparative size and excellence, illustrating the following classes: mammals, birds, reptiles and batrachians, marine invertebrates, insects, fishes. Much duplicate material for exchange, particularly birds and marine invertebrates.

Botany. 175,000 specimens. The herbarium, wholly distinct from the museum, is in charge of Thomas H. Macbride, *professor of botany*, and B. Schimick, *curator of the herbarium and assistant professor of botany*.

The collections of spermatophyta, pteridophyta, and fungi are most valuable and the largest in number. Myxomycetes, algae and bryophyta are also extensively represented. Considerable material for exchange.

Ethnology. 800 specimens: a valuable collection of skulls, ivory carving and implements from the Eskimo and Indian tribes of arctic America; pottery and utensils from Mexico, Arizona and New Mexico; and a small collection of skulls and pottery of the mound builders, from Missouri and Iowa.

Upper Iowa university, Fayette. Bruce Fink in charge.

Paleontology. 1000 specimens: Silurian and Devonian fossils of Iowa; Cretaceous fossils of Kansas; Carboniferous fossils of Pennsylvania; also a small geologic collection from Germany. Some local forms for exchange, specially *Atrypa reticularis*, and *Terebratula iowensis*.

Mineralogy. 500 minerals from American localities.

Phenomenal geology. 100 specimens: ripple marks, stalactites, geodes, concretions, peat, etc.

Zoology. 600 specimens: 25 mammals, 25 birds, 200 reptiles and fishes, 100 insects, and 200 marine invertebrates.

Botany. A herbarium of 12,000 specimens. Three fourths of the herbarium are forms lower than Anthophytae, lichens being the best represented group. An immense variety of lichens for exchange.

Ethnology. 125 paleolithic implements and relics of the American Indians.

Wartburg teachers seminary and academy, Waverly. The Rev. Frederick Lutz, *president* in charge.

Paleontology. 938 specimens: chiefly from formations of the Silurian and Devonian systems.

Mineralogy. 1434 specimens.

Historic and economic geology and lithology. 352 specimens.

Zoology. 1128 specimens illustrating every division of the animal kingdom, specially birds.

Botany. 1151 specimens: a general herbarium, and a collection of woods.

Ethnology. 452 specimens. There is an art collection connected with the museum.

Western college, Toledo. No report.

KANSAS

Baker university museum, Baldwin. C. S. Parmeter in charge, assisted by J. C. Bridwell.

Paleontology. 21,156 specimens. Several hundred duplicates for exchange.

Mineralogy. 4810 specimens. 2000 duplicates for exchange.

Historic geology and lithology. 500 specimens. 200 duplicates for exchange.

Zoology. 43,638 specimens: mammals, 60; birds, 406; eggs, 1052; reptiles, 264; insects, 32,798; mollusks, 8458; marine invertebrates, 600. 5000 duplicates for exchange.

Botany. 7789 specimens: Phanerogamia, Hepatica and Musci. 500 duplicates for exchange.

Ethnology. 900 specimens. 300 duplicates for exchange.

Bethany college, Lindsborg. J. E. Welin, *curator* in charge.

Paleontology. 500 specimens: Silurian, Devonian, Carboniferous, Jura-Trias, Cretaceous, Tertiary and Quaternary; the type specimen (a skull in good condition) of *Megalonox leidy* Lindahl. Some common fossils for exchange.

Mineralogy. 800 specimens from United States, Sweden, Africa and South America; contains specimens of almost all the mineralogic groups and serves the purpose of class elucidation.

Historic and economic geology and lithology. 100 specimens: different groups of rocks.

Zoology. 1000 specimens: mounted specimens of mammals and birds; unmounted skins of same and mammals for class study; alcoholic specimens of reptiles and all groups of marine and fresh-water invertebrates.

Botany. 1500 specimens: almost every family of flowering plants; several genera of ferns; a few mosses.

Ethnology and anthropology. 2000 specimens: a finely mounted and classified collection of Indian relics from this vicinity consisting of pottery; flint and bone implements; stone (Sioux quartzite) hammers, metates with hand pestles, some pipes and pipestone. The college has recently received a fine collection

of pottery, stone implements, doorplates, baskets, and two skulls from the cliff dwellings of New Mexico. In connection with this, there has been received a very fine collection of modern Indian pottery, stone implements, and other things of interest from the Pueblo and Apache Indians. Material for exchange.

The museum also possesses a fine collection of coins, paper money and postage stamps from every known country of the globe. It is probably the best of its kind in the state consisting of 3000 pieces of money, tokens and souvenirs.

College of Emporia, Emporia. George S. Fisher, *professor of natural science*. Collections are merely those made by students for illustration in the elementary courses.

Mineralogy. 300 specimens.

Historic geology and lithology. 200 specimens.

Zoology. 250 specimens of fishes received from the Smithsonian institution, and an equal number of insects.

Botany. 250 specimens representing local flora.

Kansas state agricultural college, Manhattan. E. A. Popenoe, *professor of entomology and zoology* in charge; G. A. Dean, *assistant in entomology*; Theodore H. Scheffer, *assistant in zoology*.

General geology. 3000 specimens: a series of common rock-forming minerals; common types of rocks; common fossils, placed with a view of affording students of the science, as given in our course, a fundamental knowledge of the subject.

Permo-Carboniferous and Cretaceous fossils for exchange. Also specimens of rocks of the vicinity.

Zoology. 8000 specimens illustrating collections in the various branches. The local reptilian fauna and mollusca are fairly well represented.

Entomology. Very complete collection of insects consisting of from 10,000 to 20,000 specimens.

Kansas Wesleyan university, Salina. Alfred W. Jones, *professor of geology and entomology*, curator.

Paleontology. 900 specimens: fossil leaves representing the Dakota group; invertebrate fossils of the Upper Carboniferous

and the Lower Cretaceous formations. These form the greater part of the paleontologic collections. A few specimens from the two latter formations for exchange.

Mineralogy. 1200 specimens general in nature, no groups being particularly prominent. A limited amount of material for exchange.

Economic and historic geology. 500 specimens.

Zoology. 7000 specimens: the A. W. Jones collection of about 5000 specimens of Coleoptera, and about 1000 insects of other orders; 50 alcoholic examples of reptiles and batrachians; 100 mounted birds and mammals and half a dozen skeletons; and several hundred marine invertebrates. Duplicate specimens of Coleoptera for exchange.

Botany. 200 native plants. A few duplicates for exchange.

Ethnology. 300 specimens: series of casts of prehistoric implements from the Smithsonian institution; several native Indian implements and trinkets; and a few relics of the mound builders.

Midland college museum, Atchison. E. B. Knerr, *professor of natural sciences and mathematics*, in charge.

Paleontology. 800 specimens: local invertebrate fossils; the Miocene invertebrates of Virginia; fossil leaves from the Dakota group of the Cretaceous in Kansas, and other specimens of the fossil fauna of Kansas.

Mineralogy. 500 specimens illustrating the common minerals, mostly obtained by purchase.

Zoology. 120 specimens: local birds and snakes; a few mounted skeletons.

Botany. 1000 specimens: most of the flowering plants and ferns of Ohio, Iowa and Kansas; a collection of liverworts from Prof. Underwood.

Ethnology. A few relics of the American Indian.

University of Kansas, Lawrence. F. H. Snow, *director*; L. L. Dyche, *curator of zoology*; S. W. Williston, *curator of paleontology*; E. Haworth, *curator of mineralogy*; W. C. Stevens, *curator of the herbarium*; S. J. Hunter, *reptiles and invertebrates*; F. H. Snow, *curator of entomology*; C. E. McClung, *curator of microscopic collections*.

Paleontology. 40,000 specimens. They have been built up by purchase and exchange, but chiefly by the personal collections of the director and the curators in summer expeditions to western Kansas, Dakota, Wyoming and Colorado. They are specially rich in Cretaceous flora and fauna, the Dakota leaves, of which there are many type specimens by Lesquereux; and the Niobrara vertebrates, specially reptiles, among which are the types described by Dr Williston. There are also many Loup Fork mammals from Kansas, White river mammals from Dakota and Wyoming, and Jurassic reptiles from Wyoming. Also extensive series of Carboniferous and Permian leaves and insects, many Lower Cretaceous and Tertiary leaves, Permian and Carboniferous vertebrates, and several mounted Pleistocene mammals. It is one of the largest university collections in the United States. Duplicates for exchange.

Mineralogy. 12,000 specimens. The chief collection is that purchased from J. W. Cooper for \$3000, consisting chiefly of specimens from the Rocky mountains. Duplicates for exchange.

Economic geology. 2000 specimens: illustrating the resources of Kansas for producing salt, gypsum, coal, building stone, lead, and zinc. Duplicates for exchange.

Zoology. This is one of the largest university collections in the United States, including North American mammals and birds, both skins and skeletons—mounted and unmounted; a collection of birds nests and eggs; a series of alcoholic specimens of reptiles; a series of marine and fresh-water shells.

Entomology. 200,000 specimens. The second largest of North American species in the United States, including 8000 species of North American coleoptera, 3500 North American Lepidoptera, 4000 Diptera, 3000 Hymenoptera and 1500 species of other orders. This collection contains many type specimens of Grote, Williston, Townsend and others. Duplicates for exchange.

Botany. 7000 mounted, and 15,000 unmounted specimens of North American plants. Duplicate material for exchange.

Ethnology. 500 specimens of mound builders implements.

Washburn college museum, Topeka. G. P. Grimsley, *professor of geology and natural history*, in charge.

Paleontology. 8000 specimens: Dakota fossil leaves from Kansas; a series of Cretaceous fossils; a series of fossils from the Carboniferous formations of Kansas; specimens of the Carboniferous flora of Ohio; and of the Lower Silurian and Devonian from the latter state.

Fossils from the Carboniferous of Kansas and from the Silurian and Devonian systems of Ohio for exchange.

Mineralogy. 500 specimens: ores and minerals of Kansas.

Historic geology and lithology. 500 specimens illustrative of the geology of Kansas.

Zoology. 2000 specimens: reptiles, fish and fresh-water shells of Kansas; mounted specimens of the buffalo, mountain lion, and smaller mammals; marine shells, corals and crustaceans.

Fresh-water shells of Kansas for exchange.

Botany. 2000 specimens: including a herbarium of the phanerogams, mosses and fungi of Kansas, and the Ellis collection of fungi. Kansas phanerogams for exchange.

This museum is very desirous of exchanging for geologic and zoologic material.

KENTUCKY

Bethel college, Russellville. No report.

Center college of Kentucky. No report.

Central university of Kentucky, Richmond. No report.

Kentucky university, Lexington. Alfred Fairhurst in charge.

Paleontology. 500 specimens of fossils, of general distribution. Faunas of the Trenton and the Corniferous limestones being best represented.

Mineralogy. 500 specimens: ordinary minerals, ores and non-metallic minerals about equally represented.

Lithology. 200 specimens of rocks, including one of the students collections distributed by the Smithsonian institution.

Zoology. 75 specimens of small mammals; 1000 specimens of birds, of which 700 are mounted; about 100 specimens of birds

eggs and a few nests; considerable material from Mexico, South America, the West Indies and Australia; a few European forms; 200 specimens of reptiles, amphibians, fishes and invertebrates in alcohol; about 50 specimens of corals and 200 species of shells.

Ethnology. 100 specimens of images, articles of domestic use, etc., from Japan and an equal number from other parts of the world; about 700 specimens of stone implements of the North American Indians.

Zoology. Smithsonian school collections.

Louisville public library. A. S. Brandeis, *chairman of the committee on cabinets and art*, in charge.

Paleontology. 1000 specimens: not yet well arranged for exhibition.

Mineralogy. 6000 specimens: the Troost collection, and the J. Lawrence Smith collection, in part, which are noted for their fulness and extent rather than for excellence in any particular groups; large and valuable collection of precious and semiprecious stones; also important series of meteorites, native metals and crystals.

Economic and historic geology and lithology. 500 specimens: the Shreve memorial cabinet, containing many rare and beautiful marbles and other ornamental stones.

Zoology. The C. W. Beckham collection of nearly 3000 carefully prepared bird skins, almost entirely American species, chiefly from the southern states; birds eggs; a few fishes and bones of fish; several hundred rare shells; a collection of starfish and a good collection of corals.

Botany. Several thousand specimens: the Williamson collection of ferns; the Beckham collection of ferns and flowers; the Mrs Belknap collection of ferns, etc.; and the Octavia Allan Shreve collection of ferns and algae.

Ethnology. 500 specimens representing all parts of the world, and many periods of time.

Ogden college, Bowling Green. Malcolm H. Crump, *professor of natural science*, director. The museum is for practical purposes only, being limited to the needs of the students.

Paleontology. 2000 specimens: working collection of typical Kentucky fossils from the Chazy to the Quaternary. Specimens of *Pentremites godoni*, *Lithostrotion canadense*, *Athyris*, *Productus*, and many sub-Carboniferous fossils for exchange.

Mineralogy. 2000 specimens: typical North Carolina specimens for working purposes, including coal, ores, clays, etc. Some specimens of calcite and limonite for exchange.

Historic and economic geology and lithology. 200 specimens: iron ores, building stone, etc. Stratified and oolitic limestone for exchange.

State geological department, Lexington, Charles J. Norwood, *curator*.

Paleontology. General systematic collection to represent Kentucky geology.

Mineralogy. General collection.

Economic geology. Collections of building stones, dressed and polished and in the rough; ores of iron, lead and zinc; clays and clay products; coals and coke constitute the main exhibited material. There are also collections of barite, fluor spar, marls, paints, salt, petroleum, etc.

Zoology. General collection including the celebrated race horse Hanover, mounted.

Botany. Principally economic. A large collection of Kentucky woods in the shape of boards, partly dressed and polished.

There are also 200 large transparencies showing farming lands, cattle and stock, timber, quarries, etc.

A number of large colored photographs, geologic and other maps and two relief maps of the state, one geologically colored, the other to show the distribution of timber. The collections are intended primarily to show the natural resources of the state of Kentucky. The museum has recently been removed from Frankfort to Lexington and is now being systematically arranged.

LOUISIANA

Louisiana state university and agricultural and mechanical college museum, Baton Rouge. The collections are distributed among the various departments and are in charge of the professors of each department.

Geology and mineralogy. Collections representative, classified and arranged.

Zoology. Several cabinets of mammals and birds; five large cabinets of shells; several hundred jars of invertebrates (all the types represented); a few dried specimens of invertebrates and a few skeletons; also many charts and drawings.

Entomology. 150 cases of insects principally southern.

Botany. Between 1500 and 2000 classified specimens and a great deal of material preserved in formalin and alcohol.

There has been recently established on the Gulf of Mexico, in Louisiana, a gulf biologic station through which the collections of this institution will be greatly increased.

Tulane university of Louisiana, Tulane museum, New Orleans. George E. Beyer, *curator and professor of biology and natural history.*

Paleontology. 3000 fossils and casts of fossils, of general distribution. The entire department is in course of reconstruction just at present.

Mineralogy. 5000 specimens: one of the largest collections in the south, representing between 400 and 500 species and varieties.

Historic geology. 300 specimens: a general stratigraphic series, illustrating rocks of the various formations and periods from the Archaean to the Quaternary; and a special series illustrating the geology of New York.

Zoology. Collections illustrate all classes and nearly all orders, those in mammalogy, ornithology, herpetology, ichthyology and conchology being extensive and specially representative of Louisiana and the southern states. Invertebrate zoology is fairly well represented, and is particularly complete in Mollusca.

There is a very good collection of glass models, made by Blaschka. Osteologic collections include complete and partial skeletons, skulls, sternums, etc.

Botany. 45,000 specimens: herbariums of Dr Josiah Hale; Prof. John Riddell; W. M. Carpenter; Herman Curtins; F. Laskar's herbarium of about 300 European medicinal plants, and Prof. T. G. Richardson's collection of cryptogams, consisting principally of Filices from South America.

Ethnology. Collection small, with the exception of the American section. There are two Egyptian mummies, with cases and wrappings, one of which is the remains of Got-Thoti-Auk, an official of high rank under Osorkon 2. The American section contains chiefly skeletons, skulls, implements and pottery of the aborigines. Mound investigations have been carried on by the curator during the last three years. Much valuable material has been accumulated. Many duplicates for exchange which may be obtained on application.

MAINE

Bates college museum, Lewiston. Arthur L. Clark, *professor of physics.*

Collections limited but representative and increasing yearly. Minerals and Carboniferous plants most prominent among the geologic material.

Bowdoin college, Brunswick. No report.

Colby college museum, Waterville. W. S. Bayley in charge.

Paleontology. 1500 specimens: general, arranged to illustrate lectures on historic geology.

Mineralogy. 3000 specimens: general.

Lithology. Exhibits: the Rosenbusch collection of typical rocks; building stones of Maine; American type specimens of rocks; also the Maine state geologic collection, embracing specimens obtained from C. T. Jackson during the first survey of the state in 1837-39.

Zoology. 500 specimens: a few mounted skeletons, and a number of alcoholic specimens.

Botany. 800 mounted specimens illustrating partially the flora of the state.

Ethnology. A set of Ward's collection of masks of Indians of the Pacific coast.

Kennebec historical society, Hall Lithgow library building, Augusta. Elizabeth M. Le Prohon, *secretary*.

Some small collections in natural history, prominent among which is a general collection of minerals.

University of Maine museum, Orono. Gilman A. Drew, *professor of biology*, in charge.

Paleontology. 1000 specimens arranged to illustrate briefly the fauna and flora of all geologic periods.

Mineralogy. 600 specimens: a general collection of 500 specimens, and a good representation of Maine minerals; an economic collection of 300 specimens.

Geology. A series of specimens illustrative of stratification and other characteristics of sedimentary rocks.

Lithology. 300 specimens.

Zoology. 2500 specimens: leading forms of both vertebrates and invertebrates of Maine; enough exotic forms for illustration of types. Material for exchange.

Botany. 15,000 specimens: the Halsted collection of New England lichens; the Cummings and Seymour collection of lichens; Cook's illustrative collection of fungi; the Ellis and Evehad collection of fungi; the Underwood collection of liverworts; the Sullivan and Lesquereaux collection of mosses; the Blake herbarium of 10,000 specimens of cryptogams and phanerogams; a special herbarium of phanerogams and cryptogams of Maine; the Halsted collection of weeds and the Harvey collection of weeds and forage plants of Maine.

Ethnology. 150 specimens gathered in Maine.

The museum is giving special attention to its collection from Maine, particularly the mammals.

MARYLAND

Johns Hopkins university, Baltimore. William Bullock Clark, *professor of geology*, assisted by Harry F. Reid, *professor of geologic physics*; Edward B. Mathews, *associate professor in mineralogy and petrography*; George B. Shattuck, *associate professor of physiographic geology*.

The paleontologic and geologic collections are described in the university publication, *Retrospect of 20 years, 1876-1896*, as follows.

The collections of the geological department consist primarily of a large amount of material brought together from Maryland and adjacent states of Virginia, Pennsylvania, Delaware and New Jersey, and include representatives of most of the important rock types, fossils and minerals from the several formations of this territory. The collections are especially rich in crystalline rocks and in Cretaceous and Tertiary fossils. Some of this material has already been described, while much awaits further study. In addition to the large amount of material thus brought together from the surrounding region, the following special collections form a portion of the university's possessions:

The Williams collection contains several thousand objects, consisting of extensive suites of specimens and of thin sections of minerals and rocks from the best known and most thoroughly studied localities in both Europe and America. They have recently been presented to the university by Mrs Williams.

The Lewis collections of rocks and thin sections, numbering over 1000 specimens, have been deposited with the university by Mrs Lewis. These specimens were collected by the late Prof. H. Carvill Lewis, and include carefully selected materials, especially from Pennsylvania, Germany, Switzerland and South Africa.

The Krantz collection of fossils contains several thousand specimens from the best known localities in Europe, being representative of all the different horizons.

The Hill collection contains a large number of specimens of rocks and characteristic fossils from the Cretaceous formations of Texas, collected by Prof. R. T. Hill, of the United States geological survey. It was presented to the university by Messrs Jesse Tyson, Francis White, Mendes Cohn, W. T. Dixon and D. C. Gilman.

The Stürtz collection comprises a suite of over 400 hand specimens and accompanying thin sections. These represent the rocks

cited by Prof. Rosenbusch in his *Mikroskopische physiographie* and are from the type localities.

The Lehmann collection, a suite of specimens and thin sections gathered by Prof. J. Lehmann, was sent by him to the university to illustrate his well known work on the crystalline schists.

The Allen collection of minerals, which is especially rich in early discoveries from American localities, includes many of the type specimens illustrating the papers of Prof. O. D. Allen, late of Yale university.

There are also private collections made by Prof. Clark and others of the department; also numerous small collections acquired by gift, exchange or purchase, among others from the United States national museum, the national surveys of Russia and Canada, the universities of Berlin, Göttingen, Harvard, Yale, Chicago, Iowa, Michigan, Alabama, etc., as well as from individuals in this country and in Europe.

Apparatus. Among the models are the following:

- 1 A set including Europe, Asia, Africa, North America, South America, United States and Pennsylvania, placed in the custody of the university by E. H. Butler & Co. of Philadelphia.

- 2 A large relief of the state of Maryland on the scale of 2 miles to an inch prepared for the World's Columbian exposition and deposited by the state geological survey.

- 3 A model of Baltimore and vicinity on the scale of 4 inches to the mile without vertical exaggeration, all of the above being the work of Cosmos Mendeleeff of Washington.

- 4 The Shaler and Davis models illustrating the development of topographic form and geologic structure.

- 5 The Heim models showing the structure of volcanic cones, glaciers, Alpine valleys and coast lines.

- 6 Models illustrating the development of the Ammonites and the different types of Foraminifera.

- 7 Several hundred models illustrating different phases of geology, paleontology and mineralogy.

In addition to the above there are several hundred lantern slides and photographs.

Library. The library in geology is very large and rapidly increasing. It contains over 6000 bound volumes and 10,000 unbound volumes and pamphlets, among them the libraries of the late Professors Williams and Lewis and the meteorologic library of Prof. Cleveland Abbe, besides several large collections of books recently purchased by friends of the university. The library is particularly rich in books of reference, containing full sets of most of the important journals as well as the publications of foreign official surveys and museums. The books cover the fields of general geology, paleontology, petrography, economic geology and mining.

Maps. Extensive suites of maps, and among them, these:

1 A set of topographical and geological maps prepared by the United States geological survey; maps prepared by the United States coast and geodetic survey, Mississippi and Missouri river commissions, United States land office, and many of the earlier national surveys.

2 Maps prepared by the various state geological and topographical surveys in the United States.

3 Partial, and in some cases complete, sets of topographical and geological maps prepared by the national surveys of Great Britain, including many of the colonies (especially Canada and Australia), France, Germany, Austria, Russia, Norway and Sweden, Italy, Holland, Belgium and Japan.

The botanic collections are described in the same publication as follows:

1 The Schimper collection of European and African flowering plants, of about 4300 sheets, the gift of Dr A. F. W. Schimper, now professor of botany in Bonn;

2 The Fitzgerald collection of American and European mosses, including about 1000 sheets, the gift of Mr Charles H. Fitzgerald, formerly of Baltimore.

Deposited with the university and available for use in its work are:

3 The local collection of flowering plants and ferns belonging to the Naturalist's field club, of about 1400 sheets;

4 The collection of American cryptogams, chiefly algae and fungi, belonging to Dr J. E. Humphrey, comprising about 2500 sheets.

Accessible to suitably prepared students, is the remarkable herbarium of Capt. John Donnell Smith of Baltimore, representing the flowering plants and ferns of many parts of the world, especially rich in the flora of tropical America, including some 85,000 sheets. The owner of this collection has generously offered to give it to the Johns Hopkins university when a suitable place can be provided for it.

Maryland academy of sciences, Baltimore. P. R. Uhler, *president*; William Wolle, *curator*; John Widgeon, *collector*.

Paleontology. 500,000 specimens nearly all from Maryland localities, from all formations in the state; Lower Helderberg and Oriskany exceptionally well represented. Triassic dinosaurian tracks; Jurassic and Lower Cretaceous plants.

Historic and economic geology and lithology. A few hundred specimens. Gneisses, granites, diorites, marbles, sandstones

and clays; geodes, stellate masses of selenite, large crystals, models, diagrams, photographs, etc.

Photographs for exchange.

Mineralogy. 5000 specimens. Over 2000 species from European and American localities. The Dr F. E. Chatard, the Dr Riley and the Dr E. A. Dalrymple collections. Many rare forms from the Bare Hills, Jones Falls, Mineral Hill, the Blue Ridge mountains and other Maryland localities.

Zoology. Many thousands of specimens representing the whole fauna of Maryland. A large series of mounted birds and mammals, reptiles and fishes are exhibited. The birds of Maryland are mounted in separate upright cases showing changes of plumage, with young, nests and eggs, etc. A very extensive collection of insects of all orders from all parts of Maryland.

There is a general collection of shells, specially rich in Unios.

Botany. A nearly complete collection of the plants of the state representing about 1500 species, 500 of which are fungi.

Ethnology. 10,000 specimens mostly Indian relics from Maryland.

Maryland geological survey, Baltimore. William Bullock Clark, *state geologist*.

Paleontology. Collection at present incomplete, but arranged to illustrate the Paleozoic, Mesozoic and Tertiary formations of Maryland.

Mineralogy. Preliminary and incomplete collection illustrating a large variety of species.

Historic geology. Collections incomplete but containing a large amount of material from the Devonian, Carboniferous, Eocene, Miocene and Pleistocene formations. A systematic collection consisting of fossils, rocks, ores, etc., representing all geologic formations, from Maryland localities, is exhibited in cases in the entrance hall of the Administration building.

Economic geology. Part of the collections are exhibited in two rooms on the ground floor of the Administration building. One room is devoted to stone and contains 60 dressed and polished cubes 8 x 8 x 8 inches of building stones from Maryland quarries,

4 polished granite risers 7 feet by 1 foot 6 inches and 4 large turned columns of granite, marble, serpentine and red sandstone, a collection of polished slabs of ornamental marbles 8 x 4 and 4 x 4 inches and slabs of polished marble and serpentine 40 x 30 inches. There are also other columns and blocks of granite, serpentine, etc. The Triassic breccia, known as the Potomac marble, from Frederick county is represented by a large polished column, slabs, blocks and partially polished boulders, and the slate of Hartford county by a series of specimens of rough blocks, split and finished slates. Samples of road-making rocks are shown with the results of tests to which they are subjected. A series of tested specimens from all available quarries in the state are kept in storage.

The other room contains principally clays and clay products. A series of clays from all the principal producing localities is kept, a typical collection being exhibited in glass jars. Pottery is well represented from most of the Maryland producers, terra cotta is shown in ornamental pieces and such blocks as are commonly used in building construction; gas retorts, furnace blocks, fire brick, stove lining and glazed bricks show the uses of fire clay, pressed brick are shown in the construction of an ornamental mantel and in panels. There is also a series of sands, ground quartz, talc, etc., shown in jars and a set of the most typical soils of the state are shown in bulk and divided into their component parts of gravel, sand, silt, clay, etc.

There is a reserve series of coal specimens kept in jars and the results of their analyses. The series of coals on exhibition consists of large cubes representing the principal coal seams of the state. Relief and geological maps and transparencies occupy the windows and wall space.

There is a geologic library of over 1000 volumes consisting largely of official reports of the national and state surveys.

Rock Hill college museum, Ellicott City. The Rev. Bro. Fabrician F. S. C. in charge.

Mineralogy. 2000 specimens for educational purposes. Used specially in connection with the study of chemistry.

Historic and economic geology. 50 specimens from the various rock formations in the vicinity of Ellicott City.

Botany. 2500 specimens including the herbarium of Prof. W. E. H. Aikin; a set of carices from Dr H. P. Sartwell of Penn Yan N. Y. and a complete set of the ferns of Howard county, Md.

Ethnology and anthropology. 800 specimens including a rare lot of specimens from Ceylon consisting of native manuscripts, photographs, coins, idols, musical instruments, trinkets, etc. Also many plaster casts of American Indian relics.

Western Maryland college, Westminster. No report.

Woman's college museum, Baltimore. Arthur Bibbins, *director*.

Paleontology. 10,000 specimens consisting of a general systematic collection of fossil animals and plants; a collection to illustrate historical geology on exhibition and a similar series for students use and a collection of miscellaneous material for determination by students. The collections are particularly rich in fossil plants from the Potomac group of Maryland and include among other types *Cycadeoidea bibbinsi*, *clarkiana*, *fisherae*, *fontaineana*, *goucheria*, *mcgeeana*, and *uhleri*, all of Ward; *Cupressanoxylon bibbinsi* Knowlton, and many others. Also the type skulls of *Cetatherium crassangulum* and *Metopocetus durinasus*, of Cope.

There are also some interesting Dinosaurian remains from Maryland localities.

Some Potomac *Cycadeoidea* and Miocene fossils for exchange.

Mineralogy. 20,000 specimens. A general exhibition series and a students series. The collection is specially rich in minerals from the vicinity of Baltimore.

Much material for exchange.

Economic geology. 5000. There is a large collection of iron ores from European and other localities as well as complete series from the once extensively worked mines of limonite and siderite of Maryland; also collections of tin, copper, zinc, lead, manganese, chrome and other ores.

Lithology. 5000 specimens. Series of clays, etc., representing the lithology of the Potomac group. Crystalline schists and igneous rocks of the Piedmont highlands of Maryland. United States geological survey educational series, etc.

Gabbro, gabbro diorite, Websterite, lherzolite, etc., described by Williams from Baltimore county for exchange.

Zoology. 20,000 specimens. General systematic series; collections of mounted and unmounted mammals and birds; a large collection of North American birds eggs, collections of mollusks, echinoderms and coelenterates, and a large collection of American and foreign lepidoptera.

Botany. 25,000 specimens, including the Edward Rowland, the Lotzy, the Humphrey and the Metcalf herbariums.

Ethnology and anthropology. 3000 specimens of American Indian remains from many localities. The local collections are very extensive. There is also a good lot of Egyptian and Babylonian material and a fine series of Mexican objects, including a series of casts of heads of native Mexicans.

The museum also contains sections of fine arts and collections of numismatics, archeologic and historic objects. The philosophical society holding monthly gatherings is under its auspices. Series of public lectures are given during the winter.

MASSACHUSETTS

Amherst college, Amherst. 1 WOODS CABINET. B. K. Emerson in charge.

Paleontology. 20,000 specimens, constituting a good general representation of the American formations, and best representing the Triassic of the Connecticut valley. There is also an exceptionally full series of vertebrate fossils from the southern Pleistocene formations; a general collection of foreign material; and a unique series of Carboniferous fishes from Scotland. Considerable material for exchange.

Mineralogy. The Shepard mineralogic collection includes 10,000 specimens of a general nature, while the collections of rutile from Massachusetts and the southern Appalachian region,

tourmalin from Paris Me., and the collection of gems, are particularly complete. The Shepard meteorite collection includes 118 aerosiderites and 180 aerolites. Material for exchange.

Lithology. 2000 specimens chiefly illustrating concretionary formations and metamorphism. A large collection in general lithology with many thin sections. Large collections illustrating the early geologic surveys of the New England states, Vermont by Prof. C. B. Adams, Connecticut by Prof. C. U. Shepard, Massachusetts by Pres. E. Hitchcock which have great historical value.

2 APPLETON CABINET. The Hitchcock ichnologic collection contains more than 20,000 specimens of reptilian tracks found in the sandstone of the Triassic formation.

Zoology. The Adams collection of shells comprising 15,000 specimens of 1200 species and a good general collection for illustration of zoology.

Botany. 4000 specimens; phanerogams, cryptogams, and other forms of lower vegetable life.

Ethnology and archeology. 1500 specimens: the Gilbert museum, a collection of stone relics of the American Indians found within 50 miles of Amherst college; 500 specimens of bas-reliefs, cylinders, coins, and seals from Nineveh and Babylon. Large slabs from Nineveh also line the walls of the entrance hall of the library.

Boston society of natural history, Boston. Museum staff: W. O. Crosby, *assistant in mineralogy and geology*; Miss M. E. Carter, *assistant in botany*; Miss L. R. Martin, Mrs J. M. A. Sheldon, Miss E. B. Bryant, *museum assistants*.

Paleontology. 22,847 specimens: the Eser general collection from south Germany of 8809 specimens, including a number of Oppel's and Heer's and one of Meyer's types; 4810 specimens of European species; 8478 specimens of American forms, including a few types; and a collection of New England fossils numbering 750 including type specimens of trilobites from Braintree Mass.

Mineralogy. 5000 specimens: representing the various groups somewhat uniformly; a special collection of 1000 New England minerals.

Geology. 4000 specimens, most fully representing the divisions of dynamic geology and petrography (lithology and petrology); historic geology not prominent.

Zoology. 120,000 specimens: mounted mammals, 118; mounted birds, 12,328, including the Lafresnaye collection, containing more than five hundred types; Samuel Cabot's collection with his types, and the Bryant collection named by Ridgway; 5000 unmounted bird skins, and 5200 birds eggs; 1000 mounted specimens received from the Boston museum and including a large part of the collection formerly in Peale's museum in Philadelphia. Among these are a number of Wilson's and Bonaparte's types and specimens figured in their works on American ornithology, also a number of specimens from both the Lewis and Clark's and Long's expeditions; reptiles, 817; amphibians, 424; fishes, 4500; mollusks 35,000, including many of the type specimens described by Gould, Bland and Binney, Achatinellae described by Gulick, and Strophias described by Maynard; crustaceans, 2500; insects 50,000, including the Harris collection, some specimens of which were named by Thomas Say, and the Burnett collection; including a number of type specimens of parasites; worms, 800; echinoderms, 1700; coelenterates, 1000; and sponges, 1475.

The Wyman anatomic collection contains many of Dr Wyman's type specimens.

Botany. 85,280 specimens: the John A. Lowell herbarium of 17,780 specimens; the C. J. Sprague collection of 2550 North American lichens; part of the Cummings, Williams and Seymour collection, 250; the Seymour and Earle collection of 450 specimens of economic fungi; a special New England collection of 4750, and the society's general herbarium of 39,500 specimens; preparations and originals from the microscopic collections of Bailey, Glenn, Greenleaf, Habirstraw, Burnett and Wyman.

Ethnology. Collections have been given to the Peabody museum of archeology and ethnology in Cambridge.

The plan of the museum has been limited in order that its growth might not interfere with the prosperity of the society and its most important function, the publication of original re-

searches. The departments of mineralogy, geology, synoptic botany and zoology and paleontology are preceded by an explanatory department giving illustrations of the principles of dynamic geology and biology. Each of these is limited in its scope, so far as exhibition is concerned, so as to teach as far as practicable, the evolution of typical structures and forms. These together form the educational series. Above these are placed the systematic collections in exactly the same order, the principle being that each department in its public exposition shall be a lesson in evolution founded on the available gradations of forms, and the whole series of departments repeat and enforce this proposition. The birds are not included in this arrangement. They have been placed on exhibition in accordance with old-fashioned standards. There is now also a New England collection in each department. These will be eventually collected into one grand series to form a New England museum which, it is hoped, will not be limited in its scope, but will strive to give a complete presentation of the natural history of New England.

Cape Ann scientific and literary association, Gloucester. Thomas Conant, *president*.

Mineralogy. 1000 specimens.

Zoology. 500 specimens: fishes and marine invertebrates found off Cape Ann.

Conchology. 200 specimens.

Botany. 200 specimens: ferns and grasses.

Ethnology. A few Indian implements found in Essex county, Mass.

City library association, natural history museum, Springfield. William Orr, *curator*; Grace L. Pettis, *assistant curator*.

Paleontology. 500 specimens: general, the Upper and Lower Silurian, Carboniferous and Triassic formations being best represented.

Mineralogy. 1300 specimens: representing all important species; 346 specimens of local minerals.

Lithology. 175 specimens of local rocks.

Historic geology. Specimens from the Triassic sandstone of the Connecticut valley showing fossil footprints.

Dynamic geology. 650 specimens.

Zoology. 4200 specimens: a series of mammals; a series of mounted birds, 12 bird groups, three mammal groups and a collection of the eggs of local birds; a few skeletons; a series of fishes; a series of corals, and collections of shells and of local insects.

Botany. A series of North American woods; woods of Nassau and California; an exhibit of Indian corn, and one of vegetable fibers. Herbarium, 1014 sheets.

Ethnology. 2000 specimens: Mexican curios; local relics of the American Indian; Russian and Scandinavian material; casts of some prehistoric implements; some relics of the colonial and revolutionary wars.

Clark hall and Thompson biological laboratory, Williams college, Williamstown. H. F. Cleland, *instructor in geology and botany*, in charge of Clark hall, and S. F. Clarke, *professor of natural history*, in charge of the biologic laboratory.

Paleontology. 3000 specimens: fair representation of all formations, augmented by Emmons's valuable type specimens from the Triassic strata of North Carolina.

Mineralogy. 1250 specimens: general, best representing calcite, augite, hornblende and scapolite.

Historic geology and lithology. A petrographic collection of 500 specimens; a series of 250 illustrating structural geology; material from the local geology about Williamstown.

Zoology. 1000 specimens of mollusks in Clark hall; many forms of mammals, birds, fishes, and invertebrates, Jackson Hall.

Botany. Three or four separate herbariums of importance; minor collections of Hepaticae and Musci.

Ethnology and archeology. A cast of the Rosetta stone; three Assyrian slabs obtained by Rawlinson and Layard; several Babylonian blocks with cuneiform inscriptions; Central American sculpture and sundry articles collected by missionaries; local antiquities relating to the French and Indian wars.

College of Holy Cross, Worcester. No report.

Harvard university museum, Cambridge. Alexander Agassiz, *director*; Nathaniel Southgate Shaler, *professor of geology*; William Morris Davis, *Sturgis professor of geology*; John Eliot Wolff, *professor of petrography and mineralogy*, curator of mineralogy; Charles Palache, *assistant professor of mineralogy*; George Lincoln Goodale, *professor of natural history*; William Gibson Farrow, *professor of cryptogamic botany*; Benjamin Lincoln Robinson, *Asa Gray professor of botany*.

Geology. The geologic collections illustrate dynamic, historical and other branches of geology, physiography and geography, etc. There are three rooms provided for exhibitions but aside from a large model by Curtis of the Boston metropolitan district there are as yet no exhibits in these rooms.

Mineralogy. The collection was founded in 1793 and is the oldest natural history collection in the university and probably the oldest public collection of minerals in America. The public collection is exhibited on two floors of the mineralogic section of the museum in flat floor cases and vertical cases arranged against the walls.

The lower or main floor contains the systematic collection arranged according to Dana's system, including about 10,000 specimens with the special collections arranged in the upper floor or gallery. The latter include a collection of 600 agates, partly cut and polished, collections illustrating the physical characters of minerals, and will ultimately include a small collection of rocks. In the gallery is the Hamlin collection of tourmalins, from Paris Me., the largest in existence. The collection of meteorites includes examples of 291 falls with a total weight of 2700 pounds; in 24 falls the museum has the largest amount of that fall. In the laboratories and workrooms connected with the museum are duplicates, specimens used for teaching etc., which bring the total mineral specimens worth enumerating to about 25,000; there are also a great many thousand specimens of rocks, with thin sections. The mineralogic museum includes a large number of rooms amply equipped for

research and teaching, including a chemical laboratory, workshop equipped with power, room for work with optical instruments, drawing room and laboratories for students.

Comparative zoology. The exhibition space in the synoptic department is divided into a series of rooms, 30x40 feet, devoted to systematic collections of typical animals, represented by mounted skins, skeletons, alcoholic and other preparations, with the object of showing the natural relationship of one class of animals with another. There are also collections to illustrate geographic distribution and rooms devoted to faunal collections of Europe, South America, etc., and to the faunal regions of the Atlantic and Pacific oceans.

The bulk of the collections are stored in trays or drawers systematically arranged so as to afford easy reference and associated with such books and facilities as may be needed for their study.

There is no information obtainable as to the extent of the collections in this museum.

Botany. The Botanical collections comprise (1) the Gray Herbarium, containing more than three hundred thousand sheets of mounted specimens. (2) the Cryptogamic Herbarium, and cases for the display of selected specimens to illustrate the principal groups of algae, fungi and lichens. (3) the Economic Museum, having, besides the material for investigation and comparison, exhibition cases filled with specimens illustrating the useful plants and their products. (4) the Ware Collection of Blaschka Glass Models of Plants and Flowers, now containing about seven hundred complete specimens of plants in flower, together with about thirty five hundred analytical details. (5) the Paleontological collection. (6) the Botanic Garden and its Greenhouses, together with Botanical Laboratories and a Lecture-room. (7) Botanical Laboratories and Lecture-rooms in the University Museum Building.

PEABODY MUSEUM OF AMERICAN ARCHEOLOGY AND ETHNOLOGY, Harvard university. Frederic Ward Putnam, *curator and Peabody professor of American archeology and ethnology*; Charles C.

Willoughby, *assistant curator*; Alice C. Fletcher, *assistant in ethnology*; Zelia Nuttall, *honorary assistant in Mexican archeology*; George Byron Gordon, *assistant in Central American archeology*; Jane Smith, *assistant librarian*; Frances H. Mead, *assistant and secretary*; Frank Russell, James H. Woods and Roland B. Dixon, *instructors in anthropology*.

The arrangement of the collections is intended to facilitate research in general anthropology, with special reference to American and comparative archeology and ethnology. The upper hall and one of the galleries are given to the Hemenway collection of archeology and ethnology of the southwestern tribes. The collections of American archeology are specially important and extensive from Peru, Colombia, Central America and Mexico, southwestern United States, the Ohio, St Johns and Delaware valleys, New England and the Pacific coast. The museum contains also archeologic collections from the French gravels and caves, from Denmark, from the Swiss lakes, and from many other regions; ethnologic collections from various parts of the world; and an important collection of human craniums and skeletons. These collections furnish the means for making direct comparisons between the art and culture of various peoples.

The regular publications of the museum are annual reports, special papers and memoirs.

SEMITIC MUSEUM, Harvard university. David Gordon Lyon, *curator*.

The Assyrian room contains casts of large collections of Assyrian, Babylonian and Hittite bas-reliefs; stone and clay tablets written in cuneiform; cylinder seals and other objects in bronze, clay and stone of Babylonian-Assyrian origin. The Palestinian room contains collections of stone inscriptions, manuscripts, coins, pottery, glass vases, bronzes, bas-reliefs, sarcophagi, etc., and photographs and collections illustrating the geology, botany and zoology of Palestine. The museum was founded by Jacob H. Schiff and was designed as the home of Semitic instruction. The library, lecture rooms, students and curators are also in the building on Divinity avenue.

Leominster public museum, Leominster. E. G. Davis, *curator*.

Paleontology. 50 specimens: fossils from various formations.

Mineralogy. 700 specimens: some interesting quartz crystals; ores and chalcedony from Colorado.

Lithology. Specimens of local granites, schists and slates.

Economic geology. Building stones, ores of precious metals, clays and grits.

Historic geology. A series of specimens and photographs illustrating the effects of the glacial period on topography.

Zoology. 200 specimens: a series of the local mammals and birds; a collection of marine shells.

Botany. 710 specimens, illustrating the local flora, ferns of Ceylon, and algae.

Massachusetts agricultural college, Amherst. R. S. Lull, *curator of museum of zoology*; G. E. Stone, *in charge of botanic museum*; H. T. Fernald, *in charge of entomologic collection*; S. F. Howard, *in charge of mineralogic collection*; J. B. Paige, *in charge of veterinary museum*.

Paleontology. About 300 specimens consisting of a small collection of invertebrate fossils for illustration in geological instruction.

Mineralogy. About 225 minerals representing groups designated by Dana and duplicates for use in determinative mineralogy.

Historic and economic geology and lithology. Soils and rocks of the state collected by Edward Hitchcock and catalogued in the *Report on the agriculture of Massachusetts* for 1858. Of the 2900 specimens which passed through a fire in 1885, 2600 have been identified and classified by Dr E. R. Flint.

Zoology. 9000 specimens consisting of a representative collection of invertebrates (not including insects) and a series of mounted mammals, birds, reptiles, amphibians and fishes, both skins and skeletons, besides numerous alcoholic specimens of the three lower classes.

Entomology. 30,000 specimens including all orders of insects and such other terrestrial arthropods as are of economic im-

portance. Under certain conditions exchanges are sometimes made.

The private collection of Prof. C. H. Fernald consists mainly of Microlepidoptera comprising nearly all of the described species of the family Pterophoridae of North America and Europe and many from South America; all the types of Fitch except one which is not in existence; all the types of Fish as well as his own types and cotypes of nearly all of the species described by Lord Walsingham from North America. It includes about nine tenths of all the types of the described species of North America belonging to this family.

Of the Tineina it contains a large number of authentically named species of North and South America together with all of his own types, a large number of those of Chambers and Miss Murtfeldt and cotypes of most of the species described from North America by Lord Walsingham.

Of the Pyralidae it contains authentic specimens of nearly all the described North American species, and many from Mexico, Central America, the West Indies, South America, Europe and other parts of the world; all of his own types and many cotypes of Hulst and Grote. This collection is rendered more valuable from the fact that the owner has compared it with all the collections in all the American and European museums containing types of North American species and critically compared and marked as homotypes such as were thus proved to be exactly like the types.

The number of species of the family Tortricidae in this collection is larger than that of any other collection in existence, being about twice as large as that of the British Museum and three times as large as that of the Berlin or Vienna museums with which it has been compared. It contains a very large number of types and cotypes as well as homotypes having been compared by the owner with nearly all of the Tortricid types in existence.

Botany. This collection consists of a herbarium in which all classes of plants are represented except the algae. It also contains sections of most of our Massachusetts woods, many forms

of natural and artificial grafts and the results of interesting physiologic experiments conducted by Pres. Clark, a collection of economic seeds, considerable miscellaneous material and some material of horticultural value such as models of fruits, etc.

The herbarium includes about 15,000 species of flowering plants and about 10,000 species of cryptogams, the latter represented by mosses, lichens and fungi.

The only specimens for exchange are the few duplicates of English mosses collected by Baker.

Ethnology and anthropology. Small collection of about 200 specimens of Ainu relics from Sapporo, Island of Yezo, Japan; 50 specimens: Egyptian material, Mexican pottery, and relics of the American Indians; an interesting collection of books, pamphlets, and manuscripts, and various relics, connected with the domestic life and industries of the early settlers of the town.

This museum is connected with the public library, both of which were established and built by popular subscription for the purpose of preserving historic matter and relics of olden times. It is therefore almost exclusively of local interest, with little, if anything, for general exchange.

Massachusetts institute of technology, Boston. William H. Niles, *professor emeritus of geology*; William O. Crosby, *associate professor of structural and economic geology*; George H. Barton, *assistant professor of geology*; Charles H. Warren, *instructor in geology*.

Paleontology. 10,000 specimens.

Mineralogy. 10,000 specimens.

Economic geology and petrography. 8000 specimens.

Structural geology. 2000 specimens.

Peabody academy of science, East India Marine hall and an addition, Salem. Founded in 1867 by George Peabody of London "for the promotion of science and useful knowledge in the county of Essex." George Augustus Peabody, *president*; Abner C. Goodell, *secretary of trustees*; John Robinson, *treasurer*;

Edward S. Morse, *director*; John H. Sears, *curator of mineralogy and geology*; Lawrence W. Jenkins, *curator of ethnology*.

Paleontology. Small synoptic exhibit of specimens illustrating the historic geology of the earth, from the oldest to the most recent formations.

Mineralogy. A complete exhibit of the minerals of Essex county (450 specimens); also 960 specimens, illustrating the school edition of Dana's *Mineralogy*.

Historic geology and lithology. A general collection of 2000 specimens illustrating historic geology; 725, illustrating the historic geology of Essex county; microscopic sections illustrating the petrography and photographs of geologic features of Essex county.

Geology. A synoptic collection illustrating the historic geology from the oldest to the most recent formations; a very full collection of the rocks of Essex county; thin sections for microscopic study, illustrating the petrography, and photographs of geologic features of Essex county.

Zoology. Nearly complete series filling 150 running feet of wall cases, of the animals of Essex county; a synoptic collection illustrating the animal kingdom from the lowest to the highest forms, arranged and labeled according to textbooks commonly used in schools and colleges of the state.

Botany. A herbarium of 4000 sheets of the plants of Essex county; a large collection of woods of the county; a general collection illustrating the vegetable kingdom and a general reference herbarium.

Archeology. A large collection of the prehistoric relics of Essex county; smaller collections representing other parts of the United States, European countries and Egypt.

Ethnology. A collection arranged by countries, illustrating the costumes, customs, implements of war and of domestic use, and objects of art of the native races of China, Japan, India, Malay archipelago, Siam, Korea, Africa, the islands of the Pacific, North and South America, etc.

This museum contains the collections of the East India Marine Society, founded in 1799, and has had an uninterrupted existence since that date.

One of the objects of the society was to form a museum of natural and artificial curiosities. The museum was begun at this time by the donation of the extensive private collection of Capt. Jonathan Carnes. Owing to the unusual facilities enjoyed by the earlier members of the society some of the results now attained are the Korean collection, one of the most important in the country; the Japanese collection, which is by far the largest in the world; and important collections of ethnologic material from the South Sea islands.

The museum is also rich in local material. The collections in botany, zoology and mineralogy of Essex county being very complete.

Since 1867 large additions have been received from the Essex institute and through the trustees and director of the academy.

There is also in the museum a historical collection of portraits of prominent Salem merchants, members and officers of the East India marine society, together with many interesting relics connected with the early history of that institution, and models and pictures of Salem merchant vessels, a suggestive memorial of the commercial history of the city.

Smith college museum, Northampton. Harris H. Wilder in charge.

The collections are small but increasing along the lines most necessary for teaching purposes. There are a few cases of typical minerals and fossils and a few hundred specimens in botany and zoology. The aim is to arrange specimens to illustrate lectures, each important class of animals is represented by a few selected specimens, as for instance, a skeleton and other anatomic preparations.

Worcester natural history society, 12 State st., Worcester. Bes-sie L. Dewhurst, *custodian of the collections*; Herbert D. Braman, *superintendent of the cabinet*.

Paleontology. 500 specimens: Vertebrata, 150; Articulata, 50; Mollusca, 250; Radiata, 300; and Protozoa, 50.

Mineralogy. 3000 specimens: 2700 specimens of wide distribution; 300 illustrating the minerals of Worcester county.

Historic geology and lithology. 3500 specimens: alluvial and diluvial material; the Eocene, Miocene, Pliocene and Carboniferous formations; chalk, greensand, oolite, red sandstone, coal, limestone, clay slate, mica slate, gneiss and eruptive rocks; rocks of Worcester county.

Zoology. 15,000 specimens: mammals, 630; birds, 400, 300 nests and eggs; reptiles, 165; fishes, 70; insects, 2000; crustaceans, 75; and 8000 lower invertebrates.

Botany. 1500 specimens: miscellaneous herbarium illustrating the flora of North America and of England; and a herbarium of Worcester county flora.

Collections specially illustrative of Worcester county.

Any of the specimens are lent for private study, and to the Worcester public schools for illustration of natural history lessons. Classes in various branches of natural history, both for adults and children, are conducted yearly.

MICHIGAN

Albion college, Albion. No report.

Alma college, Francis L. Hood memorial museum, Alma. E. H. Harper, *professor of biology, curator*, with one assistant, who is usually a student.

Paleontology. 2500 specimens: the Shroyer-Wilcox collection of 1000 species from the Cincinnati group; large general collection; two or three hundred species mainly corals from the drift and representing the various Lower Silurian types.

Mineralogy. 5000 specimens: silicates from Maine; lead and zinc ores from Joplin Mo.; and iron and copper ores from the upper peninsula of Michigan.

Historic and economic geology. 1000 specimens, illustrating the historic geology of the state; metamorphosis and degradation of rocks; building stones of the state; metals, their ores and products.

Zoology. 2500 specimens: Michigan mammals; birds of Michigan, with nests and eggs; birds of Florida, and a few species from Arizona; some alcoholic specimens of invertebrates; small

collection of tropical shells; and an incomplete series of Michigan shells. Local species for exchange.

Botany. 2000 specimens: local spermatophytes and pteridophytes; also some local forms of fungi and algae. Duplicates for exchange.

Ethnology. 200 stone implements of the American Indians.

Detroit museum of art (including the **Detroit scientific association**), Detroit. D. M. Ferry, *president*; George N. Brady, *vice-president*; Frederick E. Farnsworth, *secretary*; Collins B. Hubbard, *treasurer*; A. H. Griffith, *director*.

For list of collections, see Addenda, p. 222.

Hillsdale college, Hillsdale. No report.

Michigan college of mines, Houghton. A. E. Seaman, *professor of mineralogy and geology* in charge.

Paleontology. 1000 specimens for use in illustrating lectures; 3100 for use of students; a small type collection of living and fossil forms arranged zoologically in accordance with Nicholson's *New manual of paleontology*; 1000 fossils arranged zoologically and chronologically.

Mineralogy. 35,756 specimens: 151 crystal models in glass, 2153 crystal models in wood and plaster, 2260 natural crystals to illustrate crystallography; 485 specimens to illustrate physical and optical properties of minerals, pseudomorphs, etc.; a lecture exhibit of 10,000; 17,025 for use in laboratory work; an exhibition collection of 2550 specimens including the Emmons collection of 550; and 2132 microscope slides of minerals.

Lithology. 18,248 specimens: a lecture collection of 3800 rocks; a laboratory collection of 6500; a series of 1000 of the Rosenbusch typical rocks; 1975 specimens illustrating the formations of Michigan; and 4973 microscope slides of rocks.

Zoology. 800 specimens: chiefly invertebrates for use in instruction in classification, previous to work in paleontology.

Botany. 300 specimens of woods.

Ethnology. 250 specimens.

Michigan geological survey, Houghton. A. C. Lane, *state geologist* at Lansing, F. E. Wright at Houghton.

18,000 specimens: rocks gathered from different parts of the upper peninsula of Michigan by the survey corps, beginning with the administration of the late Charles E. Wright, in 1885, and augmented by the collections of private persons. The specimens previously collected by and under the different state geologists are now, in part, lodged in the University of Michigan at Ann Arbor. The collection of fossil corals made by former state geologist Rominger is at Ann Arbor, as is also considerable material from the lower peninsula collected by the late Dr Alexander Winchell, whose private collections are at Alma college.

Besides the collection of rocks, the survey possesses a small collection of copper and other ores and minerals from the vicinity of Houghton and a considerable number of suites representing deep drill holes in various parts of both peninsulas. These are in part at Lansing and in part at Houghton.

University of Michigan, Ann Arbor.

Historic geology and paleontology. 95,040 specimens, nearly all invertebrates: a large series from the geologic survey of the state, of which more than 100 are type specimens; the White collection of 1018 catalogue entries numbering 60,000 invertebrate fossils; the Rominger collection of 5000 species, 25,000 specimens, invertebrate fossils, which includes a) types of all Paleozoic corals described by Dr Rominger in the geologic report of Michigan, volume 3, b) stromatoporoids, c) bryozoans, d) Paleozoic fossils belonging to all other classes, e) a large number of European fossils of all ages and classes, the sponges of which form, with the American species, a very interesting series, and 250 species, 10,000 specimens of invertebrate fossils added by Dr Rominger; 40 Cretaceous and Tertiary fossils from Texas, specimens from Yellowstone park and 23 from the upper Missouri valley.

Mineralogy. 6000 specimens: the Lederer collection of 2500 minerals, principally European; rich series of Michigan minerals,

including all varieties of copper ores and associated minerals from the Lake Superior region.

Economic geology. A series of foreign and domestic building stones, deposited by the Smithsonian institution; a series illustrating the metalliferous regions of the upper peninsula of Michigan; 150 specimens of ores and rocks, deposited by the United States national museum; 39 of copper ore and associated rocks from the Wolverine copper mine; seven of native copper from the Calumet and Hecla mines; 25 of asphaltum and petroleum; samples of brine and salt from Percy's salt well, Mason county, Mich.

Physical geology and geography. A representative collection of volcanic products, including a series of specimens from Martinique and St Vincent; the deposit formed in caverns; chemical precipitates from lakes and springs; peat, lignite, coal, petroleum, asphalt etc.; meteorites, the products of rock weathering; soils etc. comprising several hundred specimens. Supplementing this collection and also used in illustrating lectures on physical geology and geography, are relief maps and models and a large number of lantern slides.

Zoology. A series illustrating the fauna of Michigan and other northern and western states; a collection of animals of the Pacific coast; many valuable specimens from the Philippine islands and other foreign countries; the Beal-Steere collection comprising numerous corals, shells, insects, birds and mammals from South America, China, Formosa, Philippines and the Moluccas.

Botany. 100,000 specimens representing 5000 species under 25,000 entries: large series of Michigan plants collected by the public surveys; several valuable herbariums and sets of plants, the most important of which are the Houghton herbarium, the Sager herbarium, the Ames herbarium, the Harrington herbarium, the Beal-Steere, the Adams-Jewett and the Garrigues collections; Collins's, Holden's and Setchell's Phycotheca Boreali-Americana; Briosi and Cavara's funghi parasiti; Seymour and Earle's economic fungi, the continuation of Ellis's

North American fungi and large additions to the cryptogamic flora of Michigan.

Archeology and ethnology. Beal-Steere collection of arms, implements, carpenters tools, musical instruments and idols of the Chinese; many articles domestic and warlike used by North American Indians and natives of the south Pacific islands; clothing of the American Indians, modern Peruvians, Formosans and natives of the East Indies and Alaska; casts from Europe and the Ohio mounds and pottery from the Cliff Dwellers of New Mexico and Arizona received from the Smithsonian institution; the valuable collection made by the late Daniel De Pue, mostly from Washtenaw county, Mich.; a fine collection of flint instruments from Denmark and an extensive collection of Peruvian burial pottery secured by the Beal-Steere expedition.

The Frederick Stearns collection of musical instruments consists of 1400 pieces (no duplicates) representing nearly all types of instruments of all nations and ages, collected with reference to its educational value as illustrating the evolution of the modern types.

The Chinese exhibit of the New Orleans cotton exposition illustrative of the culture and manufacture of cotton and its use in garments, native-made household furniture, and house and garden pottery.

MINNESOTA

Carleton college, Northfield. L. W. Chaney, *professor of biology*, in charge.

Paleontology. 12,000 specimens: Cambrian, Silurian and Coal Measures.

Mineralogy. 2000 specimens.

Zoology. 1000 specimens: for class use only.

Gustavus Adolphus college, St Peter. J. A. Edquist, *curator*, in charge.

Paleontology. 1000 specimens: general collection of 300 Silurian and Carboniferous; special collection representing Cretaceous and Jurassic flora and fauna of Laramie plains, Wyoming; left femur of Brontosaurus, 75 inches in length. Some material for exchange.

Mineralogy. 800 specimens: Smithsonian collection from different localities representing all the groups; general collection of carbonate minerals and ores being best represented. Some material for exchange.

Historic and economic geology and lithology. 1000 specimens: 200 stratigraphic specimens illustrating all the geologic formations; Smithsonian collection of 200 illustrating dynamic and structural geology; 300 general. Material for exchange.

Zoology. 1500 specimens: mounted mammals, birds and reptiles; alcoholic and histologic preparations; shells; 1000 entomologic specimens.

Botany. 5000 specimens: the Sandberg collection of Minnesota flora, 300 genera and 500 species; the Rundstrom collections of 250 genera, 350 species of American flora, and 375 genera, 800 species of Scandinavian flora. Material for exchange.

Ethnology and anthropology. 700 specimens: implements, weapons and ornaments of the American Indians; numismatic collection of silver, copper and bronze coins.

Hamline university museum of natural history, St Paul. The museum is a part of the department of biology and geology, of which Henry L. Osborn is director. Assistants are employed from time to time as needed.

Paleontology. 1000 specimens: including a general collection chiefly Paleozoic; the Lillibridge collection of fossils chiefly mollusks from the Black Hills Mesozoic, but including a few vertebrates of tertiary age; N. H. Winchell collection of Paleozoic fossils from the central states.

Mineralogy. Specimens chiefly from the Central states, the Lake Superior copper region being well represented; collections from Gouverneur N. Y.; the Yellowstone national park; and the collections of N. H. Winchell, H. L. Osborn, C. A. Waldo and F. W. Dewart.

Historic geology. 1000 specimens; a series collected by H. L. Osborn, illustrative of the glacial drift at Hamline; ores of iron and copper received from the United States national museum; a general lithologic collection made by N. H. Winchell, also one illustrating structural geology.

Zoology. 100 skins of mammals; 200 mounted birds, 400 skins of birds, and 500 birds nests and eggs; 100 articulated and 250 disarticulated skeletons; 200 alcoholic vertebrates; 100 fragile objects, vertebrate and invertebrate, in glass boxes for class use; 500 alcoholic invertebrates; 500 anatomic preparations; 1000 mounted insects; 350 dried invertebrates, exclusive of conchological specimens; 500 conchological specimens; 1000 histologic preparations; and 1500 microscope slides.

The more important donors to these collections are, the United States national museum, H. L. Osborn, the Menage scientific expedition, Otto Lugger and Eddy H. Greeley.

Botany. 3300 specimens: the H. L. Osborn collection of 2000 specimens from the northern and eastern parts of the United States; the F. W. Dewart collection of 300 specimens of the Yellowstone national park flora; the Merrill Hitchcock collection of 500 specimens of Vermont flora; collection of Mrs Thomas G. Lee of flowering plants, a collection of fungi and lichens; and a local herbarium of 500 specimens.

Ethnology. 200 specimens: from Liberia, Africa, donated by Rev. B. F. Kephart and Eddy H. Greeley; 50 relics of the American Indians received from N. J. Lillibridge.

Minnesota academy of natural sciences, Minneapolis. Charles P. Berkey, *corresponding secretary*.

Paleontology. 1000 invertebrate fossils; 500 vertebrate.

Mineralogy. 2500 specimens.

Geology. 500 rich specimens.

Zoology. 100 mammals and reptiles, 100 reserve; 1100 birds (mounted), 3500 reserve; 500 corals; 1000 shells and miscellaneous specimens. Those marked reserve are not mounted and not on exhibition.

Ethnology. 1500 weapons, tools, clothing, etc.; 300 photographs from the orient. These with the specimens under zoology are almost exclusively from the Philippine islands and the collection is one of the most complete in the world.

In the library are 9291 publications of scientific societies.

Besides the above there are loaned to other neighboring museums large collections of certain groups not counted in the list.

Minnesota geological and natural history survey, Minneapolis.
N. H. Winchell, *state geologist*.

Collections are in the custody of the University of Minnesota at Minneapolis and are described with the other collections of that university.

The geologic survey was concluded early in 1901. The publications remaining on hand were turned over to the general library of the University of Minnesota, William W. Folwell, librarian. Work in botany proceeds under the charge of Conway MacMillan and in zoology under Henry F. Nachtrieb, both of the same university.

University of Minnesota, Minneapolis. This institution has no distinctively university museum. It is however, charged with the care of the museum to be created by the geologic and natural history survey. The departments of zoology and botany have study collections which are not considered separate from the collections of the museum embraced under the geologic and natural history survey, and the heads of the departments are in charge of their respective collections. Conway MacMillan, *professor of botany*; C. W. Hall, *professor of geology and mineralogy*; Henry F. Nachtrieb, *professor of zoology*.

Paleontology. Geologic survey: over 9700 entries with many duplicates embracing 2000 fossils. For study, 2500 fossils and a fairly complete set of Ward's casts of fossils; the Sardeson collection of Paleozoic fossils which consists of a series of 32,500 specimens under 2500 entries. The collection of vertebrate fossils is begun, the anthropologic series number 300 entries.

Geology and mineralogy. Geologic survey; over 9700 entries with many duplicates embracing: 5700 rocks; 2000 minerals; 1500 thin sections of rocks and fossils; an extensive series of photographs and negatives representing geologic formations, physiographic features and microphotographs. Also for study 5000 rocks, 1400 thin sections of minerals and rocks; 6000 minerals, including the Kunz systematic collection; 2000 comprised in systematic collection; 3400 in reference collection; 1000 crystal forms; 2000 photographs; 500 negatives and several hun-

dred lantern slides. The collection of meteorites is one of high rank.

Zoology. 275,000 specimens: the reference and exhibition collections of dried and alcoholic specimens; entire and dissected specimens; sections, skeletons; models and skins; special collection of the birds, fishes, insects and mollusks of Minnesota.

The plan is to make the museum representative of the state and contemplates as full a representation of the entire fauna as possible, while extralimital material is added merely for completeness of illustration. The plan is to make the collection as complete as possible and afford facilities for students and investigators.

Botany. A herbarium of 325,000 dried specimens; 2000 jars of alcoholic and formalin material; 200 specimens of woods; 5000 plant portraits.

Minnesota species of Spermatophyta, Pteridophyta, Bryophyta, Algae, Fungi, and photographs of the same are always on hand for exchange. An exchange bureau is maintained, and the curator is in communication with hundreds of American and foreign collectors.

MISSISSIPPI

Millsaps college museum, Jackson. A. M. Muckenfuss, *professor of chemistry and physics*, in charge.

The collections are not large, and are used only for illustrative purposes. There is a small collection of local fossils.

Mississippi agricultural and mechanical college, Agricultural College. Glenn W. Herrick, *professor of biology*, in charge.

Historic and economic geology and lithology. 500 specimens.

Zoology. 10,000 specimens of insects; 70 specimens of invertebrates presented by the Smithsonian institution; a few fishes; fairly good collection of birds eggs.

Botany. A station (experiment) herbarium of 2000 phanerogams; a college herbarium of 2000 specimens; a station herbarium of 2000 fungi mostly parasitic.

University of Mississippi, museum of natural history and geology, University. Waller S. Leathers, *professor of natural history and geology*, in charge of museum.

Paleontology. Representative collection of invertebrates from the Cambrian formations upward; also sharks teeth; bones of mastodon, zeuglodon and other fossil vertebrates from the Tertiary and Pleistocene formations. A few zeuglodon vertebrae and fossiliferous concretions from Mazon creek, Illinois for exchange.

Mineralogy. A representative series of minerals, including most of the species described in Dana's *Manual*.

Economic geology. Collection made by the former state agricultural and geological survey, including rocks, soils (with many analyses of the same) and fossils of the state, arranged by counties, with some from adjoining states.

Lithology. A very fair collection, the basis of which was purchased from A. E. Foote of Philadelphia, and added to from time to time.

Zoology. Many mounted and alcoholic specimens; skeletons of vertebrates and dried invertebrates; shell collection of 10,000 varieties, purchased from Dr Francis H. Markoe.

Botany. An incomplete suite of cryptogamous plants.

Ethnology. Bones, pottery, fishhooks, arrowheads, etc., of the North American Indians and the Mound Builders.

MISSOURI

Bureau of geology and mines, Rolla. E. R. Buckley, *state geologist*. 8000 entries and 32,000 specimens illustrating the geology and mineral resources of the state exclusively.

Central college, Fayette. No report.

Christian university, Canton. No report.

Drury college, Springfield. Edward M. Shepard, *professor of geology*, in charge.

Paleontology. The collection consists of 400 specimens of Silurian, 100 Devonian, 1000 Lower Carboniferous, 500 Lower

Coal Measures, 500 Middle and Upper Coal Measures. Type specimens of Missouri Devonian fossils (*Missouri geological survey*, vol. 12, pl. 1).

Mineralogy. Tenney collection (Prof. Sanborn Tenney of Williams college) 400, Flanner collection (Dr T. U. Flanner, Michigan copper ores) 300, Missouri lead and zinc minerals 300. General collection of minerals 500.

Historic and economic geology and lithology. This collection consists of 500 specimens of Lower Carboniferous, 600 of lead and zinc minerals from all sources, Smithsonian national museum collection of rocks about 150. About 200 specimens of Tasmanian, Australian, New Zealand and Hawaiian rocks and ores.

Zoology. 200 specimens of West Indian corals and sponges; 150 specimens of the Smithsonian collection of marine invertebrates; 100 specimens of Hawaiian corals; 100 specimens of New Zealand shells; 200 specimens of Greene county (Mo.) reptiles and birds; 100 specimens of marine fishes of the Atlantic coast and the West Indies. General collection of 500 shells.

Botany. Herbarium of Greene county (Mo.) flora consisting of 600 species; herbarium of New England flora of 700 species; herbarium of 150 species of carices and grasses of United States; herbarium of 105 species of Hawaiian ferns; herbarium of 200 species of marine algae; herbarium of 200 species of fresh-water algae.

Ethnology. This collection consists of South African, Fijian and Hawaiian curios.

Prichett college museum, Glasgow. W. Newton Holmes, *professor of science*, in charge.

Paleontology. 10,000 specimens: Silurian system, 500 fossils; Carboniferous system, 5000 fossils, the brachiopods and crinoids of the Subcarboniferous being best represented; Devonian system, 200 fossils; Cretaceous formations of Texas, 1000 fossils, the *Ostrea* family being the best represented; some bones of a mastodon. 3000 duplicates for exchange.

Mineralogy. 2000 specimens: ores of silver, lead, and iron best represented; ores of tin, zinc, mercury and manganese; quartz, stalactites, etc., well represented. 500 duplicates for exchange.

Zoology. 800 specimens: mounted mammals and birds; alcoholic specimens; skeletons; shells, etc.; 100 specimens native birds; 400 alcoholic specimens of marine invertebrates. 200 duplicates for exchange.

Botany. A herbarium of 500 native plants, chiefly those flowering in the spring and early summer.

Ethnology. 250 specimens: polished stone axes; hatchets (one hematite hatchet); discoid stone; a few pieces of pottery and about 100 arrowheads, all relics of American Indians; a few specimens of bones of Mound Builders.

University of Missouri, school of mines and metallurgy, Rolla.
George E. Ladd, *director*.

Paleontology. A student collection of 500 specimens.

Mineralogy. Working collection for blowpiping, etc. 3000 to 4000 specimens; working collection in cabinet, 1000 specimens; exhibition collection 2000 specimens. Several thousand specimens from the Joplin district, Missouri, for exchange.

Historic and economic geology and lithology. 3500 specimens.

University of the state of Missouri, university museum, Columbia. The staff of the museum includes the following professors in charge of their respective collections: George Lefevre, *zoology*; C. F. Marbut, *geology and mineralogy*; F. B. Mumford, *agriculture*; J. M. Stedman, *entomology*.

Paleontology. 1500 specimens: a general collection, representing particularly well the brachiopods of the Coal Measures; the Winner collection, including the fossil fauna of Kansas City and vicinity, and the Blair collection of mastodon remains. In 1892 fire destroyed a number of Swallow's type specimens of fossils.

Mineralogy. 1500 specimens: general but specially rich in calcite, dolomite, sphalerite, galenite, and chalcopyrite from Joplin Mo.

Lithology. 2000 specimens: a series illustrating Rosenbusch's classification of rocks; collections illustrating the geology of Baltimore Md., the Lake Superior region, the Green mountains and Missouri.

Zoology. Collections of Missouri mammals, birds, reptiles, amphibians and fishes; Ward's specimens of mammals and birds, illustrative of the principal groups; specially large collection of Astacidae from the United States; collections of marine-invertebrates.

Entomology. Large Missouri collections including the remains of the original collections of C. V. Riley's *Missouri reports* and the Stedman collection. Some Missouri specimens for exchange.

Botany. A complete herbarium of the flora of Missouri and some exotics; special collections of fungi, grasses and trees of commercial value. Some Missouri specimens for exchange.

Anthropology. Skeletal, and other remains of the mound builders from Boone county, Mo., and numerous Indian relics from other parts of the state.

There is also an extensive museum of agriculture in connection with the university.

Washington university museum, St Louis. G. Hambach, *professor of geology*, in charge.

Palcontology. 40,000 specimens giving a fair representation of all geologic formations; the Shumard collection; flora of the Carboniferous, Cretaceous and Tertiary systems. No duplicates for exchange.

Mineralogy. 1000 representative specimens.

Historic geology and lithology. 2000 specimens.

Zoology. 15,000 specimens representing all classes of the animal kingdom.

Westminster college, Springfield. No report.

MONTANA

College of Montana, Deer Lodge. No report.

Montana college of agriculture and mechanic arts, Bozeman. F. W. Traphagen, *professor of mineralogy and geology*; R. A. Cooley, *professor of zoology and entomology*; J. W. Blankinship, *professor of botany*.

Paleontology. 2000 specimens representing all geologic ages specially Upper and Lower Silurian, Tertiary and Miocene. Specimens of Lower Silurian brachiopods and Upper Silurian trilobites, and Montana Middle Cambrian and Cretaceous for exchange.

Mineralogy. 5000 specimens of Montana gold, silver, copper and lead ores; metallic minerals and their associates. Specimens of chalcocite, bornite, stephanite, bismuthinite, vanadinite, asphaltum, corundum, enargite, unusually fine goslarite and hyalite for exchange.

Historic and economic geology. 500 specimens: an educational series of rocks; Judith mountain series; Montana rocks generally; 113 Voight and Hochgesang oriented sections of rock-forming minerals. Montana metamorphics and eruptives for exchange.

Zoology. 3500 species, 7000 specimens: representative animals used in demonstration before classes, and Montana vertebrates (particularly birds) and insects. Specimens of birds and insects for exchange.

Botany. Herbarium of 6000 mounted specimens and as many more unmounted; several specimens of fungi, seeds, cones, etc. in trays for exhibition purposes, and 40 specimens of the native woods of the state. Specimens for exchange.

NEBRASKA

Creighton university museum, Omaha. William F. Rigge in charge.

The museum includes altogether 10,000 specimens, arranged for use in instructing students and including representative and characteristic rather than rare specimens.

Mineralogy. 500 labeled and classified specimens, and as many more unclassified.

Doane college biological and geological museum, Crete. D. B. Perry, *president*, in charge.

Paleontology. 350 specimens, mostly from the Silurian rocks, but covering nearly all geologic periods.

Mineralogy. 600 specimens.

Zoology. 250 specimens of mammals and birds; 200 fishes, amphibians and reptiles; 500 shells; and 200 marine and freshwater invertebrates.

Botany. 2500 specimens: chiefly illustrative of Nebraska phanerogams, but represent forms from other states and Europe.

Ethnology. 150 specimens of implements, utensils, etc., of the American Indians and of African tribes.

Nebraska Wesleyan university, University Place. No report.

University of Nebraska state museum, Lincoln. Erwin H. Barbour, *acting state geologist*, curator.

Owing to lack of available space for exhibition purposes, the museum is not at present well arranged. Some valuable collections, chiefly of geologic and paleontologic material, have been obtained by class excursions from the university. 35,000 specimens have been added during the past three years by the state geological survey, being obtained chiefly from the Carboniferous and Dakota Cretaceous of Nebraska and surrounding states.

The archeologic, ethnologic, paleontologic and forestry collections are valued at \$50,000. Among the geologic material is a set of specimens of the core of a test well some 2500 feet in depth, bored near Lincoln.

The present museum is so overcrowded that arrangements have been made to store everything in fireproof buildings down town till a new museum can be built.

NEVADA

State university, Reno. No report.

NEW HAMPSHIRE

Dartmouth college, Butterfield museum, Hanover. The collections are in charge of the heads of the respective departments: C. H. Hitchcock, *geology, curator of museum*; William Patten, *zoology*; and G. R. Lyman, *botany*.

Paleontology. Collections are mostly incorporated with those illustrating historic geology. They include one of the James

Hall collections of New York fossils, obtained from the American museum of natural history; several large slabs of ichnites from the Connecticut valley; and several of Ward's casts of large vertebrate fossils.

Mineralogy. About 2000 specimens representing nearly 300 species and varieties and including the Frederick Hall collection. New England localities are best represented.

Historic geology. 4000 specimens: fossils and rocks, illustrating formations all over the United States, but particularly those of Connecticut, New York, Ohio, Indiana, Illinois, Iowa, Minnesota, Missouri, Kansas, Alabama and Colorado. 25 relief maps, one of New Hampshire and Vermont on a scale of 1 mile to an inch, and colored geologically. The sections are arranged geographically and are accompanied by colored geologic profiles to illustrate the relations of the several formations.

Economic geology. 2500 specimens: a collection of 1500, illustrating the occurrence of gold and silver ores in Montana, specially rich in the silver ores of the Cordilleras; marbles, slates and granites of New Hampshire and Vermont; and a series of petroleum specimens representing 100 localities.

Lithology. 11,700 specimens: volcanic rocks from Vesuvius and the Hawaiian volcanos, 350; massive igneous rocks of general distribution, 200; a special collection from the New Hampshire geological survey, collected to illustrate the survey reports, 250; a general collection of New Hampshire and Vermont rocks, 3500; a special collection from the White mountains, 1000; from the Ammonoosuc district, 1100; a series from the vicinity of Hanover N. H. 500; a series from the vicinities of Vernon N. H. and Bernardston Mass. 200; a set illustrating the geology of 16 sections crossing New Hampshire and Vermont, 3000; a collection of drift boulders illustrating the distribution of drift material in New England, 1500. They have been partially described in the New Hampshire reports and in bulletins of the American museum of natural history. Most of them are the official collections of the New Hampshire state geological survey.

Zoology. A collection of well mounted birds of the vicinity of Hanover, together with their nests and eggs; a collection of fishes from the United States; 2000 species of shells (mollusks) gathered by Prof. C. H. Hitchcock; 1000 species of New Hampshire insects mounted in pairs; a miscellaneous collection of about 1000 invertebrate specimens; and a large quantity of biologic preparations for use in laboratory work.

Botany. A general herbarium of 5000 species gathered by Prof. C. H. Hitchcock, and rich in ferns and marine algae; 1000 specimens of wood sections, seeds, etc., and many mosses and hepaticae; by donation from Prof. Trelease several thousand species, phanerogams and ferns, and by donation the herbarium of Prof. H. G. Jesup.

Ethnology and archeology. 500 aboriginal implements from Lake Winnipiseogee, and other localities; 90 skulls and pieces of pottery of the Mound Builders; 400 ethnologic specimens from Zululand, Alaska and the South Sea islands; many photographs of American Indians, and a full sized figure made by the Smithsonian institution, of Chief Joseph; a few Roman antiquities; a collection of Burmese and Japanese antiquities, and eight or nine unusually fine sculptures from Nineveh, obtained by Dr Wright about 1860.

The handsome museum building is the gift of the late Ralph Butterfield M.D. of Kansas City.

Keene high school museum, Keene. Percy S. Brayton, *submaster of the school*, curator.

Palaeontology. 150 specimens of corals, mollusks and fishes, from the western states.

Mineralogy. 2000 specimens for class use.

Historic and economic geology and lithology. Collections very small.

Zoology. 3000 specimens: mounted mammals and birds; skulls and skeletons; shells and insects; and small collections of corals and reptiles.

Botany. 500 specimens illustrating the flowering plants and the ferns of New Hampshire.

Ethnology. 500 specimens: relics of the local tribes of American Indians including articles of clothing, arrow points, pestles, knives, etc.

Keene natural history society, Keene. George A. Wheelock, *president*.

The geologic collection of 1000 specimens is not systematic, but consists of miscellaneous local material. It answers well the needs of the high school teachers who have charge of it, and for whose benefit it is intended. There are also biologic collections.

New Hampshire college of agriculture and the mechanic arts, Durham. Clarence M. Weed, *professor of zoology and entomology*; Charles L. Parsons, *professor of chemistry and mineralogy*.

Geology. A set of the rocks of the state; a good sized reference collection of minerals; a relief map of New Hampshire and Vermont and a few corals and miscellaneous specimens.

NEW JERSEY

New Jersey geological survey, Henry B. Kümmel, state geologist.

The collections made by this department are in the custody of the New Jersey state museum and are described with the other collections of that museum.

New Jersey state museum, Trenton. Commissioners: state sup't of public instruction, Charles J. Baxter, *president*; state geologist, H. B. Kümmel, *secretary*; pres. state board agriculture, E. B. Voorhees; president of the state senate; speaker of the assembly; S. R. Morse.

Paleontology. Several thousand specimens representing Cambrian, Ordovician, Silurian, Lower Devonian, Triassic, Cretaceous and Tertiary. For type specimens see Whitfield's *United States monograph on Brachiopoda, Lamellibranchiata, Gastropoda and Cephalopoda of the Raritan clays and the greensand marls*.

Historic and economic geology and lithology. 3000 specimens: iron ores; zinc; clays; green sand marls, etc.

Mineralogy. 1500 specimens. Synoptic collection of minerals of the state.

Zoology. 325 specimens: birds and mammals with nests and eggs. Also a collection of insects injurious to forests, prepared by Dr John B. Smith of Rutgers college for exhibition at the Pan-American exposition.

Botany. Collection kept at Rutgers college. A new collection of New Jersey woods is being made, which contains now 100 specimens intended as an educational exhibit. It includes the leaves, flowers and fruit of the trees.

Ethnology and anthropology. A small collection of Indian relics.

Princeton university museums, Princeton. William Libbey, *professor of physical geography and director of the E. M. museum of geology and archeology*; Arnold E. Ortmann, *curator of invertebrate paleontology*; Marcus S. Farr, *curator of vertebrate paleontology*; Henry B. Cornwall, *professor of applied chemistry and mineralogy and director of mineralogical cabinet*; Alexander H. Phillips, *assistant professor of mineralogy*; George Macloskie, *professor of biology and director of the John C. Green school of science, biological museum*; Walter M. Rankin, *assistant professor of biology and curator of the zoological museum*; Allan Marquand, *professor of archeology and history of art and director of the museum of historic art*.

Paleontology. 15,000 species: skeletons of a mastodon, Irish elk, cave bear and some of the extinct birds of New Zealand; a skull of the Uintatherium and a remarkably complete skeleton of Cervalces; mounted casts of the gigantic reptiles and mammals of the Secondary, Tertiary and Quaternary ages; a very perfect collection of vertebrate and invertebrate fossils from Europe and America illustrating the principal organic forms of all the geologic epochs; fine Eocene, Oligocene and Miocene fossils, many of which are type specimens, procured in the west by the various collecting parties from the university; a series of fossil plants from Colorado, many of which are type specimens. The typical fossils selected agree, so far as possible, with those mentioned in Dana's *Geology* as characteristic of different geologic periods.

One of the most important collections in the geological museum is that made by the expeditions to Patagonia conducted by J. B. Hatcher in 1896-99. This consists of a very extensive series of Cretaceous and Tertiary invertebrates, including a large number of types of new genera and species, and of about 2000 mammals from the Patagonian and Santa Cruzian (Miocene) beds.

The mammals are remarkable not only for their variety, but also for their state of preservation, very many complete or nearly complete skeletons, representative of all the orders, being among them.

These collections form the subject of the forthcoming *Reports of the Princeton university expeditions to Patagonia*, now in course of publication.

Mineralogy. About 10,000 specimens. 2600 specimens: mostly crystals, bequeathed to the university by the late Archibald MacMartin of New York. The perfection of the specimens and the number of localities represented by each species make this collection one of special value.

There are also three cabinets of minerals in the laboratory of the school of science. The principal one contains over 5000 specimens, embracing nearly every mineral species. Two smaller cabinets, one with labeled and the other with unlabeled minerals, are provided for practice with the classes, and to these the students have free access.

A very fine collection of New Jersey zinc and iron minerals from the Sterling mines was recently presented to the university, and is exhibited in the main laboratory.

Historic geology. A unique collection of 5000 specimens of erratic boulders and drift material from Switzerland; a systematic series of the typical rocks and fossils of New Jersey; and one of the typical rocks of New York representing the series as described by the geologic survey of that state. The geologic collections are all arranged with a special view to the purposes of comparative study.

Lithology. In the laboratory of the school of science are 240 specimens of typical rocks, together with a large number of Fuess's and other rock sections for study.

Zoology. 1600 mounted and disarticulated skeletons of mammals, birds, reptiles and fishes. There are over 12,000 specimens in the ornithologic collections starting with a mounted collection of representative New Jersey birds. The relations of these to the avifauna of the world is shown by collections of unmounted skins in the following groups: North America, Europe, Indo-Australia and South America. The South American collection has been materially augmented through the work done by the Hatcher expeditions to Patagonia, the results being some 600 birds. The collections are further supplemented by some four thousand sets of eggs, many of them in nests, as well as much alcoholic material and many skeletons. 2000 European and Asiatic birds have recently been received through exchange with the British museum of natural history. Mr W. E. D. Scott is curator of ornithology.

Among the invertebrates are a series of ascidians, echinoderms, mollusks, 5000 specimens; corals, 6000 specimens; sponges and microscopic preparations of small forms. 1500 preparations illustrating comparative morphology of the vertebrate organs.

Botany. Collections are arranged for exhibition and also as a working laboratory for students. The plants are classified according to the *Pflanzenfamilien* of Engler & Prantl and include specimens from the different sections of the United States and from South America, Europe and Australia. Recently the herbarium has been increased by the addition of collections of hepaticae, mosses and other plants, made by Dr Hatcher in western Patagonia and Fuegia.

There are extra specimens for laboratory use and for dissection, together with the necessary library and instruments.

Archeology and ethnology. Relics of the Swiss lake dwellings and numerous implements of stone and bronze from Denmark;

several hundred flint instruments from most of the classic localities of the Paleolithic and Neolithic ages of France; pottery and human remains of the Mound Builders; several hundred specimens of Mexican and Peruvian pottery and a number of recent Indian relics; interesting ethnologic collections of objects, chiefly from Alaska and New Mexico, presented by Dr Sheldon Jackson to the theologic seminary of Princeton and transferred to this museum by the trustees of that institution, with the consent of the donor; a series of models of the cliff dwellings and pueblos of the southwest, executed under the direction of Dr Hayden.

There is also a museum of historic art containing collections illustrative of the history and processes of the graphic arts; reproductions of Greek and Roman coins and gems; specimens of Greek and Roman marble; a collection of bronze medals; casts of ivories from the Roman to the Gothic period. A series of casts from the arch of Trajan at Beneventum has been recently added.

The Trumbull-Prime collection, illustrative of the history of pottery and porcelain, has been arranged in new cases. Egypt is represented by sepulchral figurines, beads and amulets; Phenicia by numerous Cypriote vases; Greece, Etruria and southern Italy by Corinthian aryballi and fine examples of larger vases of black figured and red figured types. The Orient is further illustrated by specimens from Persia, China and Japan; South America by Peruvian pottery. The collection is rich in examples of European wares, to which England, France, Germany and Holland are the chief contributors, but Italy, Russia, Sweden and Switzerland are also represented. The collection comprises about 20,000 specimens. A small room in the same story contains a collection of pottery loaned by Mrs W. S. Livingston and is noteworthy for the illustrative material it furnishes for the early history of our country.

The staircase and basement are occupied by carefully selected specimens of casts of ancient and medieval sculpture, presented by the class of 1881 at its decennial. This collection was formed to illustrate the history of ancient sculpture in Egypt, Babylon

and Assyria, Persia, Greece and Rome and of medieval sculpture in Italy, France and Germany. There has been recently added from the same fund a collection of casts of renaissance sculpture.

Rutgers college, The George H. Cook museum of geology, New Brunswick. Albert H. Chester, *professor of mineralogy and chemistry, curator*, assisted by W. S. Valiant.

Paleontology. 5750 specimens divided among the various geologic systems as follows: Lower Silurian, including fossils from the earlier formations and a fine lot of trilobites, with appendaged *Triarthrus becki* from Rome N. Y. 300; Upper Silurian, 400; Devonian, 450; Carboniferous plant remains mostly from Pennsylvania, Germany and Nova Scotia, 300; animal remains, 300; Triassic, 75; Jurassic, 525, mostly from foreign localities; Cretaceous, 2500, mostly from New Jersey; Tertiary, 1000; Quaternary, 500.

A great many of the type specimens used by Prof. R. P. Whitfield in his report on the fossils of the clays and marls of New Jersey are in this museum.

Some of the more prominent fossils in the museum are the Mannington (N. J.) mastodon; the original of the eurypterid *Stylonurus excelsior*, of the Devonian; saurian remains from the Cretaceous formations of New Jersey; and a slab of Jura-Triassic sandstone from Morris county, N. J., showing footprints of 15 species of dinosaurians.

Mineralogy. 11,700 specimens: the George H. Cook collection of 4500 specimens, with a large showing of New Jersey minerals—specially from the Franklin zinc mines, and the various trap rock quarries through the state; the Lewis C. Beck collection of 3000 specimens, mostly collected in New York from 1830 to 1850; Prof. A. H. Chester's private collection of 4550 specimens, one of the finest private collections in the country, is in the laboratory for use in teaching.

Many duplicates for exchange.

Geology. 1500 specimens: basaltic columns, large rock masses, geodes, concretions, fulgurites, ripple and rain markings, mud cracks, glacial striae, etc.

Historic and economic geology. 1100 specimens: illustrating the rocks, iron and zinc ores, clays, sands, marls (including the fossil bones and shells found in them) of New Jersey; a core from a diamond drill showing a section of the rocks at the Franklin zinc mines 1378 feet in depth.

Duplicates for exchange.

Zoology. Working collections in general zoology, entomology, etc.; a right whale caught in the Raritan river; a giant crab from Japan; recent ganoid fishes; and 1550 specimens of recent mollusks.

The zoologic collections, and those of botany, agriculture, art, engineering, etc., are in their respective departments, and not open regularly to the public.

Ethnology. 1700 Paleolithic and Neolithic implements, known as the "J. H. Frazee collection", that are exhibited with the geologic material.

NEW MEXICO

New Mexico college of agriculture and mechanic arts, Mesilla Park. E. O. Wooton, *professor of biology and botanist of experiment station*, in charge.

Paleontology. 200 specimens: small and general, belonging to the biologist.

Mineralogy. 500 specimens: United States geological survey educational series of rocks; unclassified New Mexican material.

Zoology. 150 specimens: a few for demonstrative purposes; a large collection of insects containing types of recently described species, and particularly rich in scale insects of the world and New Mexico bees.

Botany. 4500 specimens, mostly New Mexican: herbarium of the experiment station and biologist's private herbarium; 25 types of Wooton's species and cotypes of Greene, Heller, and Aven Nelson; and F. S. Earle's recently named species. Local New Mexican flora for exchange.

NEW YORK

Alfred university museum, Alfred. E. S. Babcock, *professor of chemistry*, in charge of the mineral collections. The other collections are in charge of A. R. Crandall, *professor of natural history*.

Paleontology. 1500 fossil species, chiefly Paleozoic, illustrated by 10,000 specimens: the type collection of the Allen museum, including Mesozoic and Cenozoic fossils not yet fully arranged.

The collection is rich in fossil sponges from the Devonian formations, but poor in primordial forms.

Duplicates of fossil sponges and of the more common forms for exchange.

Mineralogy. Gold, silver, copper and other ores, illustrated by 600 specimens; a general collection of 1000 specimens of minerals, representing 200 species and varieties.

Historic geology and lithology. Collections illustrate New York formations, and partially the terranes of some other states. Duplicates of local rocks for exchange.

Zoology. 20,000 specimens: a few mounted mammals; mounted skins of 122 species of the local birds, with their nests and eggs; 2000 species of insects, not well preserved; 1000 specimens of marine mollusks; 500 univalves and other shells and 200 Unionidae.

A few birds, and many Unionidae and marine shells for exchange.

Botany. The department herbarium of 6000 specimens, illustrating 1200 species; a collection of the local woods in the Allen museum. Specimens of the local flora for exchange.

Ethnology. Collections of the Allen museum amounting to 5000 specimens: weapons, implements, ornaments, etc., of the American Indians; a collection of 1436 coins, one third of which are of ancient, the remainder being of modern nations; pottery and illustrations of the ceramic and other industrial arts, ancient and modern; also household belongings and objects relating to social and religious customs of various peoples.

Material of the local tribes of American Indians for exchange.

American museum of natural history, Central park, New York. Morris K. Jesup, *president*; Hermon C. Bumpus, *director*; John H. Winser, *secretary and assistant treasurer*; Albert S. Bickmore, *curator of the department of public instruction*; R. P. Whitfield, *curator of geology and invertebrate paleontology*, Edmund O. Hovey, *associate*; L. P. Gratacap, *curator of mineralogy and in charge of conchology*; Henry Fairfield Osborn, *curator of vertebrate paleontology*, W. D. Matthew and O. P. Hay, *assistants*; J. A. Allen, *curator of mammalogy and ornithology*, Frank M. Chapman, *associate*; Frederic W. Putnam, *curator of anthropology*; Franz Boas, *curator of ethnology*; Marshall H. Saville, *curator of Mexican and Central American archeology*, Harlan I. Smith, *assistant curator*; William Beutenmüller, *curator of entomology*; A. Woodward, *librarian*.

Geology and paleontology. INVERTEBRATE PALEONTOLOGY, 8000 type and figured specimens. Most of these are in the James Hall collection of geologic and paleontologic material based on the New York state natural history publications, illustrative of the paleontology of the New York system and consisting of a general collection of a large proportion of the invertebrate forms illustrated in those volumes; and also specimens of the fish remains of the same geologic formations both in New York and from the other states and Canada, where the same geologic formations are known.

The Holmes collection of fossils, illustrated in Tuomey and Holmes's *Pliocene and post-Pliocene fossils of South Carolina*; the type series of the minute fossils of the Spergen hill beds, Ind., which are figured and redescribed in volume 1 of the museum bulletin, and again in the 12th annual report of the Indiana geological survey; most of the specimens illustrated in the state cabinet reports; all the types of fossils illustrated in the bulletin of the museum, consisting of many rare and unique forms, including fossils from Lake Champlain and the surrounding regions; a very extensive collection of Cretaceous fossils from Jamaica W. I., containing many rare and peculiar forms of Rudistae, etc.; a very large and nearly complete collection of

the Cretaceous fossils from Syria, including the Mt Lebanon district; trilobites from the Potsdam sandstones of Wisconsin, figured and described in the 16th report of the state cabinet; a series of Niagara group fossils from Waldron Ind., illustrated in the 28th report of the state cabinet; the type series of eurypterids from the Waterlime beds of Waterville, Williamsville and East Buffalo N. Y.; also the specimen of fossil scorpion from the same formation, described in the bulletin of the museum by R. P. Whitfield. This array of type material of invertebrate fossils brought together in one collection and in one room far exceeds that of any other collection known.

The department exhibits collections illustrating the geology and paleontology of Iowa and Wisconsin as given in the geologic reports of those states, with geologic specimens showing the grouping of fossils in the rocks and the lithologic and phenomenal features; a typical series of the bryozoans of the Cincinnati beds, described, determined and labeled by E. O. Ulrich; a large collection of fossil fishes from the Green river and Twin creek Tertiary beds of Wyoming; many from the Jurassic slates of Solenhofen, Bavaria; and a large collection of Devonian fossil fishes from the Portage shales of Lorain county, O. presented by W. E. Dodge. There is also a collection of fossil fishes of the Jura-Trias beds of the Connecticut valley and Boonton N. J., and a general collection of fossils from various European countries, from different sources, largely from Prof. Karl von Zittel and Prof. Lindström, containing a typical series of the fossil plants from Oeningen, identified and labeled by Prof. Heer; a collection of Devonian fossil plants obtained by exchange from Sir William Dawson; an interesting and instructive series of fossil cycad trunks from Dakota, and a series of fossil gums from Demarara, Zanzibar etc., inclosing leaves, insects, arachnoids, etc.

VERTEBRATE PALEONTOLOGY. A The Cope collection of fossil mammals of North America gathered by the late Prof. Cope between 1870 and 1890, and presented to the museum by trustees and friends in 1895 and 1900. It contains 500 types and 1000

figured specimens in a total of 9000: types of nearly all the species described by Prof. Cope, except of those collected by the Wheeler survey and now in the national museum.

B Fossil mammals collected by American museum expeditions 1891-1901 in the ancient lake basins of the west, specially those of Tertiary age: all types of species described, and specimens figured in American museum bulletins. Only a part has yet been prepared for exhibition.

C Fossil reptiles collected in the western Jurassic, Cretaceous and Tertiary beds by American museum expeditions. Not yet on exhibition.

D Exchange collections from European museums, Munich, Oxford, Paris, London, Stuttgart and Leipzig.

E Pampean collection by Ameghino and others purchased by Prof. Cope in Paris, 1878, and sold by him to the American museum in 1900.

F Other specimens presented by friends or purchased by the museum.

Specially noteworthy features of the exhibits are: Series showing the evolution of the horse, rhinoceros, titanotheres, amblypod, sloth, tapir and other western American types; complete mounted skeletons of Titanotherium, Palaeosyops, Hyrachtherium (the four-toed horse), Coryphodon, Hoplophoneus (a saber-tooth tiger), Aceratherium, Metamynodon and Hyrachyus (the three American types of rhinoceros), Phenacodus and Euprotogonia (primitive ungulate types), mastodon, Irish elk, and numerous others not yet ready for exhibition; fine series of complete skulls of Uintatheres (Dinoceras), titanotheres, American rhinoceroses, etc.; the Mesozoic Mammalia or multituberculates and early American primates, primitive ungulates and carnivores.

The specimens not placed on exhibition are intended for use as study collections, and are fully labeled and arranged so as to be most easily accessible to students.

Mineralogy. The famous Bement collection, with which is incorporated the reserve series; the Tiffany gem collection, now

known as the Morgan gift, separately installed; a collection of 500 meteorites, representing 450 falls with two large Greenland irons brought back by Lieut. Peary; massive specimens of Bisbee copper ores with several stalactites delicately colored by blue and green copper carbonates, and a fine series of wall case specimens extending over 1500 running feet of shelves. There is in connection with certain of the collections an introductory series embracing a group of photographs of mineral localities.

Historic geology. Besides those mentioned with paleontologic material are: a series of fossils illustrating two thirds of the species in Dana's *Manual of geology*, 3d edition, three fourths being the original specimens figured; a series of rocks collected by Prof. C. H. Hitchcock, illustrating the lithologic features of the White mountain ranges and a series illustrating 12 sections across New Hampshire and Vermont, collected and labeled by the author of the reports on the geology of those states; rocks and fossils illustrating the geology of the Island of Yesso, Japan, from the Japanese governmental survey.

Economic geology. 1000 different samples, cut uniformly with one face polished, of building and ornamental stones of the United States.

Zoology. **MAMMALS.** 1000 mounted specimens, about 16,000 skins, and nearly the same number of skulls and skeletons. The exhibition collection includes a special series of groups illustrating the species found within 50 miles of New York city, and also several of the larger mammals of North America, as the bison, moose etc.

BIRDS. 65,000 specimens, of which about 12,000 are mounted and on exhibition, and about 50 groups of North American birds mounted to show their nesting habits with facsimile reproductions of their natural surroundings. The bird collection includes a large number of skeletons and many nests and eggs.

REPTILES, BATRACHIANS, AND FISHES. The collections of lower vertebrates are large and exhaustive, but at present only a few examples are on exhibition.

INSECTS. Between 350,000 and 400,000 specimens from all parts of the world. It is particularly rich in the Lepidoptera

and the Cbleoptera, represented by large suites of specimens showing the variation and intergradation of the species. Contains many type specimens and valuable uniques. The exhibition collection is represented by many thousand specimens, viz, insects found within 50 miles of New York city; a general collection of beetles; a collection showing insect architecture and mimicry; an economic collection and collections of butterflies of the world.

INVERTEBRATES. An exceedingly valuable collection of corals is temporarily installed in Mineral hall. Other collections of invertebrates have been placed in various portions of the building till a suitable exhibition hall has been provided.

SHELLS. The John Jay (Wolfe memorial) collection with which is incorporated the great William Haines cabinet, the D. Jackson Steward collection, and the Binney and Bland collection of American land shells; all arranged and displayed with illustrative maps, figures and photographs.

Botany. The Jesup collection of woods presents a complete series of sections of the trees of North America. These sections are so cut and prepared as to show the adaptability of the various kinds of woods for various uses in the arts, and they are accompanied by illustrations colored by hand, which show the plants in flower and fruit.

Anthropology. Contains specially rich ethnologic collections from the North Pacific coast of America and from the Eskimo regions of Greenland, Hudson bay, and Alaska; ethnologic exhibits from the United States, Mexico, Eastern Siberia, China, Japan, Polynesia, and Africa; archeologic collections from various parts of the United States and Canada; a specially important exhibit from Mexico and Central America, of value in the study of symbols and hieroglyphs; also collections of pottery and objects of jadeite and copper; large groups of specimens illustrating the ancient cultures of the West Indies, Colombia, Peru, Bolivia, and Europe; and the Andrew Ellicott Douglass collection illustrating the forms of prehistoric implements in the United States and other countries.

Library. The library, formed principally through large and generous donations, contains 54,050 volumes and a large number of pamphlets and maps. These include works on the various branches of natural science, viz, anthropology, archeology, ethnology, conchology, entomology, ornithology, mammalogy, ichthyology, herpetology, botany, anatomy, geology, paleontology, mineralogy, agriculture, general zoology, voyages and travels and history relating to natural science. The periodicals and serials in the library have been obtained largely through the exchange of the museum annual reports, bulletins and memoirs.

Binghamton academy of sciences, Binghamton. N. M. Pierce, *president*.

This society owns several collections, but owing to the need of exhibition rooms, the material is not classified or arranged for reference.

Brooklyn institute of arts and sciences museum, Brooklyn. Franklin W. Hooper, *director*; William H. Goodyear, *curator of fine arts*; Alfred G. Mayer, *curator of natural sciences*; John S. McKay, *curator of physical sciences*; George K. Cherrie, *curator of ornithology*; Jacob Doll, *curator of entomology*; Carl Schaeffer, *assistant curator of entomology*; Abel J. Grout, *curator of botany*; Susan A. Hutchinson, *department librarian*.

Paleontology. The Gebhard collection of 7000 fossils representing all the formations of Schoharie county; the Eugene G. Blackford collection of fossil fishes; the Frederick Braun collection (loan) of fossils, and minerals, 2000 specimens and a general collection in paleontology.

Mineralogy. A general collection of more than 3000 specimens.

Lithology. Collections of European plutonic rocks and of the rocks of New York city and vicinity.

Entomology. The Berthold Neumögen collection of Lepidoptera, numbering more than 50,000 specimens; the Edward L. Graef collection of Lepidoptera, numbering more than 20,000 specimens; the Jacob Doll collection (loan) of Lepidoptera, numbering more than 40,000 specimens; and the Calverly collection

of Coleoptera and Lepidoptera, numbering more than 20,000 specimens.

Conchology. A general collection of more than 12,000 specimens.

Ornithology. A general collection of 1200 mounted birds and bird skins.

General zoology. A collection of mammals, reptiles and fishes and invertebrates, estimated at 15,000 specimens.

Botany. A collection of mounted specimens of flowering plants numbering 40,000 specimens including collections presented by William Calverly, the late Rev. Charles H. Hall D.D. and the late Rev. George D. Hulst Ph.D.

Ethnology and archeology. The William Wallace Tooker collection of 8000 Indian relics of Long Island. The Charles A. Schieren collection of pottery from the cliff dwellers and Pueblos of the southwest. The Sturgis collection (loan) of implements from the South Sea islands. The C. W. Riggs collection of pottery from the ancient Pueblos of New Mexico and Arizona. Also collections from the Swiss lake dwellers, from the mounds of the Mississippi Valley, Mexico and Peru.

Geography. Geographic collection, comprising more than 4000 maps, charts, cartoons, globes, models, atlases and other apparatus and publications.

Fine arts. The Tissot collection of 450 pictures illustrating the life of Christ. A collection of paintings presented to the institute, and a loan collection of paintings. A collection of casts representing Greek and Greco-Roman sculpture. 6000 photographs illustrating the history of art. Also collections of engravings, etchings and coins. The Robert B. Woodward collection of ancient glass, mainly from Syria. Collections of Japanese pottery and articles of vertu.

Buffalo society of natural sciences museum and library, Library building, Buffalo. Elizabeth J. Letson, *director*; Lee H. Smith, *president*; T. Guilford Smith, *vice president*; James Savage, *secretary*; Philip Smith, *librarian*.

Paleontology. 31,000 specimens including duplicates: 1593 labeled fossils from foreign localities; the local collection of 567 specimens, particularly rich in crustaceans from the Waterlime group in the vicinity of Buffalo, there being some 80 varieties and 200 specimens of Pterygotus, Eurypterus, and Ceratiocaris; some interesting fish remains from the Corniferous, Hamilton and Portage groups, among which are specimens of the ventral armor of Dinichthys, plates of Homosteus(?), scales of Paleoniscus, etc. Material from the vicinity of Buffalo for exchange.

Mineralogy. The "Wadsworth collection" of 2836 specimens almost entirely from European localities, and specially rich in fine groups of fluorite, calcite, quartz and iron ore, of which there are some duplicates for exchange.

Historic geology. Local 573 specimens; general 1602 specimens.

Lithology. 2505 specimens.

Zoology. 7079 specimens: herpetology, 441; ichthyology, 144; conchology, 3332; entomology, 1535; ornithology, collection of 479 local and 596 foreign birds; 460 trays of eggs; mammalogy, 92 specimens, including a series of six American bison, whose fur shows the changes undergone at different seasons of the year.

Botany. 14,935 specimens: a very complete herbarium from Buffalo and vicinity.

Ethnology. 5000 specimens: 300 specimens of pottery from the province of Chiriqui, Central America; relics of the mound builders, mostly from Arkansas; and cliff dwellers pottery from Colorado; 3000 relics of the American Indians from their burial grounds near Buffalo. The greater part of these specimens are pottery, with a few flint implements. A large collection of North American Indian baskets and collection of material from the west coast of Africa.

One room in the building is devoted to the geology of Buffalo and vicinity.

Buffalo state normal school museum, Buffalo. I. P. Bishop in charge.

Paleontology. Three or four hundred specimens of Paleozoic invertebrates, mostly from the Silurian and Devonian systems.

Mineralogy. 300 species of the more common minerals collected from various sources; one set of Ward's "normal school" collection of 185 specimens, and a set illustrating color, glance, cleavage, etc. The species occurring in the metamorphic rocks of New York are well represented.

Historic geology. 50 specimens of metamorphic rocks, and stratified rocks from the typical localities.

Zoology. 100 mounted specimens of birds, and 50 alcoholic specimens, mostly vertebrates.

Botany. A herbarium of 300 or 400 species illustrating the local flora.

Canisius college, Buffalo. Rev. Frederic J. Hillig S. J., *professor of sciences*, in charge; Rev. Henry Wolff S. J., *assistant curator*.

Paleontology. 1000 specimens: 300 New York fossils; 300 Cretaceous fossils (Maastricht, Holland); 75 from the Bad Lands, South Dakota; 50 specimens of petrified wood.

Mineralogy. 800 specimens best representing calcite and silicates.

Historic and economic geology and lithology. 550 specimens: 250 rocks arranged by Ward, Rochester; 300 chiefly local.

Zoology. 50 North American and European mammals; 300 birds from United States, Austria and Denmark; 100 reptiles, etc. including some rare specimens from India; 2500 insects, illustrating the principal orders, specially Coleoptera and Hymenoptera, and including specimens from India, Brazil, Egypt, West Indies, Holland, etc.

Botany. 1600 specimens: American herbarium, 800; European herbarium, 100; European fungi, 500; seed collection, 200.

Ethnology and anthropology. 3000 specimens: Indian curios (Dakota), 50; old English curiosities, 300; coin collection including old Roman and medieval silver coins, 2500.

The museum also possesses 300 old books from 250 to 400 years old, including an interesting collection of about 50 old Bibles.

Colgate university museum of geology and natural history, Hamilton. Albert Perry Brigham, *curator*.

Paleontology. Collection is arranged zoologically, and contains several hundred specimens, chiefly of Paleozoic age.

Mineralogy. 1500 specimens fairly representative of all the groups.

Lithology. 500 specimens.

Historic geology. 1600 specimens largely of Paleozoic age.

Economic geology. 50 cubes of building stones from various horizons; 200 bottles of crude petroleum from most of the known petroleum regions; 25 specimens of oil sands, and 50 refined products of petroleum; and several hundred specimens of ores of gold, silver, copper, iron, etc.

Zoology. 1400 mounted birds; 1300 invertebrates, including many fine corals and tropical shells.

Botany. The Douglas herbarium of species from northeastern United States, of 1600 specimens, in 33 volumes; the Cobb collection of 1100 specimens of mosses, lichens, and ferns.

Ethnology. Garments, utensils, weapons, etc., from foreign missionary fields.

College of the City of New York, New York. William Stratford, *professor of natural history*, in charge of museum.

Paleontology. 500 specimens used chiefly for teaching. New York state formations best represented.

Mineralogy. 7500 specimens: consisting of a type collection of 1500 specimens; minerals of New York city, specially of the island of Manhattan, 2500; and sets for teaching.

Historic and economic geology and lithology. 2400 specimens.

Zoology. 3750 specimens: 1) type collections of vertebrates and invertebrates; 2) birds of New York city, Zerega collection; 3) insects of New York city, Dean collection; 4) fishes of New York city, Blackford collection; 5) many exotic forms; 6) corals, Decker collection; 7) corals, McFarlane collection; 8) Decker miscellaneous collection.

Botany. 550 specimens consisting of a working herbarium and several small collections of woods, seeds, fibers and fabrics.

Ethnology and anthropology. Small collection used for teaching.

The museum represents the local fauna and flora, minerals and rocks. A very complete set of zoologic types. A collection representing the industries of the city, e. g. furs, textile fabrics, tobacco, etc.

Columbia university museum, Columbia university, Morningside hights, New York city. Collections are in charge of the professors in the various departments: geology and paleontology, J. F. Kemp, assisted by A. W. Grabau, *adjunct professor*, and A. A. Julien, *curator*; mineralogy, A. J. Moses, assisted by L. McL. Luquer, *instructor*, A. F. Rogers, *tutor*, and J. S. McCord, *assistant*; zoology, H. F. Osborn, and E. B. Wilson, assisted by Bashford Dean, *adjunct professor*, G. N. Calkins, *instructor*, O. S. Strong and J. H. McGregor, *tutors*; botany, L. M. Underwood, assisted by C. C. Curtis, *tutor*, and J. K. Small, *curator*.

Paleontology. 50,000 specimens: extensive collections in invertebrate paleontology and fossil fishes, containing numerous type specimens in each of these divisions and specially rich in fishes from the formations of the Devonian and Carboniferous systems. The extensive collections of fossil plants formerly in this museum are now deposited at the New York botanic garden. Many duplicates for exchange.

Mineralogy. 25,000 specimens: an introductory collection illustrating the physical properties, characters, etc., of minerals; a systematic collection of many thousands of specimens of very wide distribution; working collections for use of students in the laboratory and in lectures. Many duplicates for exchange.

Historic geology. An attempt is made to illustrate the stratigraphy of North America, and to a smaller degree, of Europe; a dynamic collection illustrating the genesis and alteration of rocks.

Economic geology. Collections very complete illustrating specially the resources of North America and including ores, building stones and the minerals composing them; minerals used in the chemical industries.

Lithology. 25,000 specimens: working collections of rocks for both elementary and advanced work in petrography. Material for exchange.

Zoology. A good working series, specially rich in the Puget sound fauna, and embryologic preparations.

Botany. 500,000 specimens: the university collection proper; collections of the following botanists: Torrey, Meisner, and Chapman; the Austin and the Jaeger moss herbariums; and many smaller collections. Collections and library will be placed in the Bronx park botanic garden, where the advanced work will be carried on. Many duplicates for exchange.

Ethnology. The university avails itself of the collections of the American museum of natural history.

Cornell university museum, Ithaca. There is no museum staff, the collections being in charge of the professors of the several departments. Geology (including paleontology, mineralogy, economic geology and physical geography), Ralph S. Tarr, *professor of dynamic geology and physical geography*; Gilbert D. Harris, *assistant professor of paleontology*; A. C. Gill, *assistant professor of mineralogy and petrography*; Heinrich Ries, *assistant professor of economic geology*, and student assistants. Department of entomology and invertebrate zoology, John H. Comstock, *professor of entomology and general invertebrate zoology*; M. V. Slingerland, *assistant entomologist*; Alexander D. MacGillivray and W. A. Riley, *instructors in entomology*. Department of vertebrate zoology, Burt G. Wilder, *professor of neurology, vertebrate zoology and physiology*. G. S. Hopkins, *assistant professor of veterinary anatomy and anatomical methods*; B. B. Stroud, *instructor in physiology, vertebrate zoology and neurology*. Department of botany, George F. Atkinson, *professor of botany*; L. H. Bailey, *professor of general and experimental horticulture*; W. W. Rowlee, *assistant professor of botany*; G. N. Lau-man, *instructor in horticulture*; E. J. Durand and Karl McKay Wiegand, *instructors in botany*, and Robert Shore, *assistant to professor of botany and head gardener*. Department of classical

archeology and history of art, Eugene P. Andrews, *instructor in classical archeology and curator of the museum of casts.*

Paleontology. Very complete collections including the following valuable material: The Jewett collection, accumulated by the late Col. Jewett when curator of the state cabinet of natural history, which is specially rich in New York fossils, containing many of the original specimens described in the state reports, and not a few unique specimens; rich faunas of the Cretaceous and Tertiary formations along the eastern and southern parts of the Union; a large number of characteristic English and European fossils; a fine series of English Mesozoic fossils; of Tertiary fossils from Santo Domingo; of preglacial fossils from Sweden; and numerous smaller collections from various typical localities in our own country; the Ward series of casts; the unique collection from Brazil made by Prof. Hartt and party on the Morgan expedition, containing the original specimens and a great number of duplicates.

Mineralogy. A large series of exhibition specimens arranged systematically and many thousand specimens arranged in study series; the Silliman collection accumulated by the late Benjamin Silliman jr, and illustrating the rarer and commoner mineral species; notable additions made from year to year by purchase and donation.

Economic geology. Collections illustrating the ores and useful minerals of the United States and to some extent foreign countries, and, though of recent date, already beginning to represent in detail the resources of the country. The collections of raw materials are supplemented by manufactured products. A number of mine models are being added.

Physical geography. An extensive series of maps, models and photographs of physiographic phenomena, largely for class use.

Zoology. The extensive collections are divided into exhibition and study series. The greatest pains have been taken to obtain and exhibit representative animal forms from all parts of the world, and carefully made dissections illustrating zoologic and morphologic ideas, such as the unity of general structure under

diversity of external form and mode of life; resemblances and differences between members of widely divergent types, and also between closely related groups, as man and the apes; the existence of apparently useless or injurious organs, etc. There is abundant material for the investigations of advanced students. In the number of well preserved and instructively prepared specimens of the brains of man and other animals, the museum is believed to be unequaled in this country.

The invertebrates include an excellent collection of corals and a very large collection of shells, the Newcomb collection. The museum also contains the complete series of glass models of invertebrates made by Blaschka, the papier-maché models of Auzoux, and a complete set of zoologic diagrams of Leuckart. The laboratory is kept supplied with alcoholic specimens of the typical marine forms studied by the students and supplied to them at cost.

Entomology. Many exotic insects and specimens of a large proportion of the more common species of the United States, which have been determined by specialists, and are accessible for comparison; sets of specimens illustrative of the metamorphoses and habits of insects; duplicates in the laboratory for the use of students; an equipment of microscopes and other apparatus necessary for practical work in entomology; an extensive and constantly increasing collection of histologic and embryologic specimens; full sets of typical specimens for study and comparison by the students.

Botany. Collections are very extensive but are not exhibited in the museum proper. The large greenhouses in connection with Sage college adjoin the rooms of the department, and are filled with many exotics representing the pteridophytes, gymnosperms and angiosperms, and offer available material at all seasons for studies in development, and histology, and furnish living plants for illustrative material for many of the lectures.

Space is provided for the study of plant growth, physiologic experiments, and for the handling and treatment of greenhouse plants, the latter being in charge of the head gardener of the de-

partment. The department also contains a large and growing herbarium, as well as collections of fruits, cones, nuts, fibers, a general collection of economic products, and a large number of specimens of the woods of different countries.

The flora of the region of Ithaca is very rich in species, and presents excellent opportunities for the student of systematic botany, and some facilities in the study of geographic botany.

Excellent facilities are offered to the students who are fitting themselves for (experiment) economic work in the courses of plant histology and in the study of the fungi. While the laboratory is distant from the seashore, it is well supplied with material of the marine algae for morphologic and developmental study of typical forms, and material preserved specially for the purpose is also supplied for investigations in development.

The collections also include the Auzoux and Brendel models representing the different groups of the plants, and other illustrative material in the way of charts, maps, etc.

Archeology. Collections are in a department by themselves. The museum of classical archeology, occupying the first floor of McGraw hall, is composed chiefly of casts representing the history of Greek and Roman sculptural art, but is also supplied with various plans, models, reconstructions, facsimiles of coins, etc. The nucleus of the collection was purchased with a fund of \$7000 donated for the purpose by the Hon. Henry W. Sage. The instruction in archeology and history of art is given in part in the museum itself.

There is also a series of several thousand photographs of ancient ruins and architecture.

Glen Island museum of natural history, New Rochelle. Lewis M. McCormick, *curator*.

Zoology. Specimens comprise: 500 mounted birds, mostly from the state of New York, but including a few brilliant colored tropical birds; 4000 specimens of shells, 200 of corals, 100 of sponges, and a few skeletons, including a camel's and ibex's, and one of the three skulls of the Atlantic right whale preserved in this country; also in the zoologic garden, several hundred specimens of birds and animals confined in cages.

Botany. 500 specimens: an excellent series of the algae of Long Island sound.

Ethnology. Weapons and utensils from Somaliland, and the west coast of Africa, from Arabia and Egypt; also relics of the American Indians, of the pioneer settlers of America, and of the war of the rebellion; American coins and script money; an interesting collection relating to the whaling industry of New England.

The Glen Island museum is maintained and arranged for the instruction and entertainment of visitors to the resort, and is not intended so much as a place for research as for popular illustration in the various branches of natural history. To this end, special attention is being given to the descriptive labeling of specimens, and to the use of pictures, specially with the ethnologic exhibits. Typical, large, showy specimens receive the preference over the rarer forms prized by museums of research, but a strict standard of authenticity is maintained in all the collections.

Hamilton college, Clinton. Charles H. Smyth jr, *Stone professor of geology and mineralogy.*

Paleontology. 2500 specimens of fossils and rocks illustrating the geology of New York; 1750 illustrating the formations and the life of the United States; 600 fossils chiefly from Silurian formations of Europe; 500 fossil corals from the United States.

Mineralogy. A series of 10,000 specimens of minerals, of general distribution; a special series of New York minerals called "The Oren Root collection of New York state minerals."

Historic geology and lithology. 250 specimens from the new red sandstone, besides those mentioned under paleontology; United States geological survey educational series of rocks, 156 specimens; 80 specimens to illustrate the geology of the Lake Superior region; a large number of Adirondack rocks.

Economic geology. 1000 specimens of ores, coals, petroleums, building stones, etc.

Zoology. 2000 specimens of land, fresh-water and marine shells and a rare collection of Japanese shells; 300 ornithologic specimens from China; a case of New Zealand birds from the *Transit of Venus* expedition of 1874; 300 birds from Oneida

county, N. Y.; the Barlow collection of 13,000 entomologic specimens to which Judge Barlow has added valuable collections in ornithology and comparative anatomy; a series of 391 Japanese insects.

Botany. 3354 flowering plants and 395 ferns; a collection from China; Sartwell herbarium, the result of 50 years' work in botany, containing 8000 specimens of plants cured, labeled and classified in 62 volumes, and including 451 mosses, 226 lichens, 342 seaweeds, 600 fungi, 575 ferns, 314 grasses, 200 Ericaceae.

Hobart college museum, Geneva. As the chair of geology is vacant at present, the museum is in charge of Herbert R. Moody, *professor of chemistry*.

The paleontologic, geologic and mineralogic equipment comprises many thousands of specimens and many duplicates, but no catalogues are available at present.

Paleontology. Representative collection of the New York terranes; a nearly complete set of Ward's casts of vertebrate fossils; the original of Ward's cast of *Castoroides ohioensis*.

The collections in the departments of natural history and in ethnology are representative, but are in need of better facilities for exhibition.

Long Island historical society museum, Brooklyn. The office of curator vacant. Mary E. Ingalls, *assistant curator*, in charge.

Paleontology. 892 specimens: chiefly from New York state, and donated by the state geologic survey.

Mineralogy. A few hundred specimens, chiefly from New York state.

Historic geology. A series of 746 specimens of rocks, sands and clays from the glacial drift of Long Island; 148 of the rocks of Manhattan Island; charts of the rocks cut through in boring for the piers of the Brooklyn bridge, and for wells at Jericho L. I., College Point L. I. and Woodruff's pier, Brooklyn; cores from diamond drill borings at Hunters point, foot of Atlantic avenue, Brooklyn, and off the Battery point, New York city; 16 specimens from a well at Jericho L. I.; 5 from a well of the Nassau gaslight co., Brooklyn; 47 from Barnum's island, East Rockaway bay; 6 from Calvary cemetery, Laurel Hill Brooklyn; 5 from Fort Lafayette; 50 from Woodhaven L. I.; 30 from the

piers of the Brooklyn bridge; 11 from Wheatley hill; and 6 from Westbury station L. I.

Economic geology. Marbles from the United States.

Lithology. A few hundred specimens, including a general collection; 168 specimens of sands, clays and peats.

Zoology. 2000 specimens: 119 mammals; 750 specimens of the birds of Long Island, representing nearly all the native species; 923 birds eggs; 198 reptiles; many of the crustaceans and nearly all the shells of the Long Island coast; and a large collection of land and marine shells from the East and West Indies.

Botany. 4000 specimens: 87 species of woods native to Long Island; 800 land plants, including mosses and lichens; nearly complete collection of marine and fresh-water algae of Long Island; a herbarium of 3000 specimens of the flora of the western and southern states collected by the late Prof. George Scarborough of Vineland N. J.; large collection of foreign algae; 80 sheets of English algae prepared by Dr John Lightfoot, author of *Flora Scotia*, published in 1777.

Ethnology and archeology. 1600 specimens: 782 Indian relics from Long Island, including axes, scrapers, arrow and spear points, pottery, etc.; 93 Indian antiquities from western mounds; 108 specimens taken from graves at Ancon, Peru; 18 from Mexico; eight carvings from temples in southern India; musical instruments from India; material from the Pacific islands; Chinese games, dominos and cards; 80 Egyptian relics from tombs of the kings, near Thebes, including cloths, carved wooden images, heads, etc.; 92 specimens from China and Japan; a cast of the Rosetta stone; and cast of the egg of the Aepyornis, or "roc" of eastern tradition; case of relics from the wars of the revolution and rebellion.

Natural science association of Staten Island, New Brighton. C. A. Ingalls, *curator*; Arthur Hollick, *secretary*.

Mineralogy. 200 specimens: minerals from the serpentine area which extends from New Brighton to Richmond, Staten Island; minerals from the trap quarries at Graniteville; and those from the limonite beds.

Lithology. 200 specimens: 50 representing the native rocks of Staten Island (Archæan, Paleozoic, Triassic, Cretaceous and Tertiary); the remainder, erratics from the drift.

Paleontology and historic geology. 500 specimens: granites and serpentines of the pre-Cambrian; Mesozoic fossil plants in red shale and diabase of the Triassic; fossil plants and mollusks in the clays and specimens of fire clay and kaolin of the Cretaceous; silicified corals and fossil plants in the yellow gravel and limonite of the Tertiary; fossils from the boulders of the glacial drift, plant remains and mastodon molars; scratched boulders, clays and gravels, etc., of the glacial period of the Quaternary.

Zoology. 600 specimens: mammals; birds and their eggs; insects; crustaceans and shells.

Botany. 3000 specimens: the herbariums of Dr N. L. Britton, and Dr Arthur Hollick, representing the flora of Staten island.

Ethnology. 400 specimens of local Indian relics, including axes, arrowheads, hammerstones, net sinkers, pottery, etc.; also historic relics of the revolutionary war, including muskets, cannon balls, military buttons, spurs, coins, etc.; some old views, pamphlets, newspapers, posters, etc., relating to Staten island history.

The museum is strictly local, hence no effort has been made to exchange specimens.

New York state museum. University of the State of New York. Albany.

ADMINISTRATION AND GEOLOGY. Frederick J. H. Merrill, *director and state geologist*; Henry H. Hindshaw, *assistant in geology*; Frederick C. Paulmier, *assistant in zoology*; Herbert P. Whitlock, *assistant in mineralogy*; Harry C. Magnus, *junior assistant in geology*; Joseph Morje, *clerk and stenographer*; C. Adelbert Trask, *junior clerk*; Edward C. Kenny, *stenographer*.

PALEONTOLOGY. John M. Clarke, *state paleontologist*; Rudolph Ruedemann, *assistant state paleontologist*; D. D. Luther, *field assistant*; G. S. Barkentin, *draftsman*; Philip Ast, *lithographer*; Jacob Van Deloo, *clerk and stenographer*; Martin Sheehy, *helper*; H. S. Mattimore, *page and preparator*.

BOTANY. Charles H. Peck, *state botanist*.

ENTOMOLOGY. Ephraim Porter Felt, *state entomologist*; Charles H. Walker, *entomologist's assistant*; D. B. Young, *entomologist's assistant*; George W. V. Spellacy, *page*.

ETHNOLOGY. Rev. W. M. Beauchamp, *author of bulletins*.

Historic and structural geology. An introductory collection, about 300 specimens, is arranged to illustrate geologic terms and definitions; a systematic collection, about 3000 specimens of rocks arranged in ascending series, with explanatory labels and maps showing distribution, represent the geology of the state. There is also a collection containing 3000 specimens mostly collected by the older geologists of the state survey. This contains many large coral masses and slabs of fossiliferous rocks. A number of large specimens illustrate various structural features.

A good series of relief maps constitute a prominent feature of the museum. It includes the following models: southern New England, scale 2 miles to the inch; New York city and vicinity, scale 1 mile to the inch; Manhattan island, scale 1000 feet to the inch, showing the present street system and the roads and topography as they existed in 1776; Manhattan island, scale 1000 feet to the inch, colored to show the geology; Catskill mountains, scale 1 mile to the inch, showing the exact proportion between elevation and distance; Adirondack mountains, scale 1 mile to the inch; Syracuse and vicinity, scale 1 mile to the inch; Niagara gorge and vicinity, scale 500 feet to one inch.

Lithology. The collections are large but are mostly stored for want of exhibition room. The exhibition material includes: the Rosenbusch collection of massive rocks, 500 specimens; 100 specimens of foreign and domestic marbles and a series of rocks from the crystalline areas of the state.

Collections of the rocks of the state and of New Hampshire, the Rohn collection of rocks of the Lake Superior region and a series of sandstones and crystalline rocks of Pennsylvania are in storage.

Economic geology. There are very complete series of the state collections on exhibition.

75 12-inch dressed cubes constitute the main exhibit of building stones. There are also columns, slabs, etc. of marbles and granites and a large number of specimens of extralimital material, principally of such stones as are of commercial importance in the state.

The iron ore collection includes a series of large masses of magnetite, hematite, limonite and siderite from mines which

have been extensively worked, also very complete series of smaller specimens. The nonmetallic minerals are shown in a series of large cases and include very complete series of New York salt with supplementary material from England, Germany, and other salt-producing localities. Gypsum, lime, cements, quartz, feldspar, garnet, corundum, graphite and all other minerals of the state are exhibited in series from the crude material to the manufactured product. A series of New York state oils and specimens of the oil-bearing rocks and sands are shown. A large collection of clays and clay products fills all the space which can be devoted to it.

Paleontology. 1,000,000 specimens, mostly Paleozoic invertebrates derived from the New York formations; including upward of 5000 type and figured specimens which have been used in the publications on New York paleontology; also many unique specimens of Paleozoic fish. Most of the fossils are in boxes and drawers in the State Hall, not many on exhibition but all accessible to students. Fine slabs of medusae, crinoids, crustaceans and trails are here exhibited. The types are systematically arranged in the laboratory of the state paleontologist except for those on exhibition in Geological Hall.

In Geological Hall a series of 7000 typical specimens arranged stratigraphically to show the characteristic fauna of each formation. Although this collection has been made with special reference to New York, materials from outside have been freely used to complete the series up to and including the Carboniferous. A number of large Devonian trees and algae are exhibited and also slabs of trilobite, worm and reptilian tracks from various formations.

There is also a series of European Paleozoic invertebrates; a series of more recent invertebrates, largely European; the Cohoes mastodon (mounted); the Monroe mastodon (unmounted); a nearly complete skeleton of the Irish elk; a series of casts of large vertebrates and other vertebrate remains.

Mineralogy. 10,000 specimens, including the Gebhard, the Albany institute, the Emmons and the Kuntz collections. A systematic collection of 3000 specimens many of which are from the old iron and other mines of the state; an economic collec-

tion of 500 specimens; a crystallographic series and 800 specimens to illustrate special groups on exhibition. There is also a superb collection of hydrosilicates from Bergen Hill, N. J. and collections of meteorites and gem materials. Many duplicates for exchange.

Zoology. REPTILES. 37 species, 125 specimens as follows: alcoholic and mounted 101, casts 6, skeletons 7, skulls, etc. 11.

AMPHIBIA. 19 species, 92 specimens, alcoholic 86, casts 3, skeletons 3.

FISHES. 194 species, 1799 specimens, alcoholic 1737, mounted 18, casts 22, skeletons 12, teeth, jaws, etc. 10.

INVERTEBRATES. 250 species, 1786 specimens identified, a considerable number still unnamed. Besides these the museum possesses large collections of shells, including the Gould collection with 6000 species and some 60,000 specimens, a collection of shells from Mazatlan presented by Mr P. P. Carpenter, and a collection of New York shells specially rich in Unionidae.

The zoologic collections are mainly intended to represent the fauna of New York state.

Entomology. The Lintner memorial collection comprising some 4800 species, is specially rich in Noctuidae, and though not on exhibition, is open to students. Large additions are made yearly to the extensive biologic and systematic collections which are being arranged and classified as rapidly as means will permit. These are accessible only to specialists. There is a general exhibit of the more important insects affecting fruit trees, small fruits, garden crops and grains, comprising about 100 species and representing the various stages of each insects development together with its work so far as material permits. A special collection of species annoying or destructive about houses and those affecting stored products has been arranged along similar lines. A small collection of beneficial insects illustrates some of the more important of these forms and another of scale insects gives a good idea of the general appearance of members of this exceedingly destructive group. The forms injurious to forest and shade trees are well represented, the various stages and methods of work being illustrated in the two latter groups so far as possible. There is a special col-

lection of about 50 species illustrating the work of gall insects, and a general idea of the class Insecta may be gained from a small systematic collection of over 600 species and representing most of the important groups. In addition there are small collections in Denton tablets illustrating protective mimicry and some of our more beautiful native butterflies and moths, and a technical collection of 60 different articles illustrates the methods of collecting and preserving insects. Another collection representing the principal differences between the common, malarial and yellow fever mosquitos is on exhibition and small collections illustrating the species commonly occurring in spring, summer and fall and those of interest on account of unusual form, size or other characters are exhibited for the convenience of teachers and their pupils.

Botany. The space in Geological Hall assigned to the botanic department is on the second floor in the southern extension of the building. It is divided into two rooms. The front room is used for exhibition purposes and contains sections of the trunks of 75 of the trees native to New York, which are cut to show the vertical, transverse and tangential sections, one half of each section being polished and the other being left unfinished in order to give an idea of the appearance of the wood. There are also some specimens of historic interest and specimens showing various forms of injuries to trees and their natural repair. Photographs of trees and thin sections of their wood are exhibited in swinging frames, supported by upright standards; a collection of edible and poisonous mushrooms and an economic collection are shown in table cases. The rear room contains the office of the botanist, the library, the herbarium and workshop.

The herbarium contains about 9000 sheets of New York plants excluding fungi, 10,000 fungi and 25,000 sheets of extralimital species and duplicates.

Ethnology. A large collection of material pertaining almost entirely to the Indian tribes of the state, including masks, pottery, arrowheads, spearheads, amulets, scrapers, clothing, cradle frames, etc., is on exhibition on the fourth floor of the capitol.

The museum has also a fine collection of wampum belts.

New York university, University Heights. John J. Stevenson, *professor of geology*; Charles L. Bristol, *professor of biology*.

Paleontology. 16,000 specimens.

Mineralogy and lithology. 1500 minerals, rock-forming minerals and rocks.

Economic geology. 8000 specimens; coal, iron and oil are specially well represented. There are specimens from all known oil-producing localities and important illustrations of individual mines of gold, silver and copper.

Zoology. Large collections specially rich in Bermuda materials but only about 1000 specimens on exhibition.

Ethnology. Only a small part of the collection, about 500 specimens on exhibition. Most of the collections are at present in storage till room can be provided for their reception.

Niagara university museum, Niagara. The Rev. George J. Eckhardt, in charge; the Rev. J. A. Tracy and James F. Houlihan, *assistants*.

Paleontology. 2000 specimens. Also 40 typical specimens of the Clinton, Medina, Chemung and Niagara formations. About 200 specimens for exchange.

Mineralogy and economic geology. 400 specimens from New York, New Jersey, Colorado, California, Canada, Ireland and Italy divided into the following groups: quartz, feldspar, sandstones, limestones, carbon and metallic ores. About 50 specimens for exchange.

Lithology. Specimens from the Medina, Clinton, and Niagara formations.

Zoology. 130 specimens of native mammals, birds, reptiles, eggs and insects.

Botany. 300 specimens of native plants. There are also specimens in this department for exchange.

Ethnology and anthropology. About 60 emblems of worship and domestic articles; American, Chinese, Japanese and African; a few anatomic specimens. 100 numismatic specimens.

The museum will be glad to exchange fossils from the vicinity of Niagara for ethnologic and zoologic specimens.

Polytechnic institute museum, Brooklyn. Henry Sanger Snow in charge.

Paleontology. 1000 specimens: chiefly of Paleozoic age.

Mineralogy. 3000 specimens including what was formerly known as the Smith collection which is particularly rich in micas.

Economic geology. A series of ores, chiefly of silver, copper and iron.

Lithology. 500 specimens: series of plutonic and metamorphic rocks.

Zoology. 1000 specimens: chiefly shells and insects.

Ethnology. 100 implements of the stone and bronze ages.

Rensselaer polytechnic institute museum, Troy. The museum is under the direction of the trustees of the institute, and in charge of the instructors in the departments represented. John M. Clarke, *professor of geology and mineralogy.*

Paleontology. 1500 specimens adapted to purposes of instruction: chiefly from the Paleozoic rocks of New York and Pennsylvania with no type specimens, and largely the donations of Prof. James Hall.

Mineralogy. A collection of about 5000 selected minerals of great historic value, the choicest specimens of which constitute the students study collection.

Lithology. 3000 specimens: a very complete collection of recent volcanic rocks; a good series illustrating the structure of crystalline rocks; a series representing structural and dynamic phenomena; an economic collection of about 1500 specimens illustrating nonmetallic produces, metallic ores, and metallurgical processes and products.

Zoology. A collection of recent Mollusca comprising about 10,000 specimens; a small series of invertebrates and vertebrates for students' use; about 350 specimens of mounted birds, and a few mammals.

Botany. A general herbarium of 5000 plants; and about 300 specimens of woods.

Ethnology. Collection small.

St Lawrence university museum, Canton. William N. Logan, *curator*.

Paleontology. 1000 specimens consisting of fossil forms from nearly all geologic horizons between Cambrian and Pleistocene; also 100 specimens of ferns from the Coal Measures.

Mineralogy. 4000 specimens, the greater part arranged in cases; also 1500 specimens including 1000 polished marbles, granites, etc.: and 500 hand specimens including the United States museum educational series.

Geology. 300 specimens including clay stones, coals, glaciated stones, etc.

Zoology. 299 alcoholic specimens; 100 specimens of corals, sponges, etc.; also 500 conchological specimens, including a special collection of American unios. Small collections in entomology.

Botany. A small collection of ferns, woods, etc.

Ethnology. A small collection of arrows, pottery, and stone implements.

Syracuse university museum of natural history, Syracuse. James R. Day, *chancellor*; Charles W. Hargitt, *curator of biological museum*; Thomas C. Hopkins, *curator of geological museum*.

Paleontology. 1700 specimens: a series of 1000 specimens illustrating the paleontology of New York; a more general collection of 200 specimens; Ward's series of 500 specimens illustrating historic geology, including many casts of rarer specimens. Material for exchange.

Mineralogy. 5000 specimens; including a general collection of 250; the French collections of crystals and minerals 210; and the Cooper collection of 500 to 600 specimens of quartz and its varieties.

Economic geology. 300 specimens: ores and smelter products.

Lithology. 400 specimens: illustrating the principal types of igneous, sedimentary and metamorphic rocks.

Zoology. 1000 specimens: Mammalia, Reptilia, and Amphibia; a collection of birds, both mounted and unmounted; a series of fishes, illustrating the principal genera of the United States; collections of shells illustrating most of the principal families and genera.

Botany. 7200 specimens: a herbarium of phanerogams, including native forms and many from foreign localities.

Ethnology and anthropology. Indian implements and pottery; coins; a number of models, casts, and engraved tablets from ancient Egypt.

Union college natural history museum, Schenectady. James H. Stoller, *professor of biology and geology*, in charge.

Paleontology. 3000 specimens: fossils mostly from the Paleozoic formations of New York and the Carboniferous and Permian formations of Kansas and Nebraska; type specimens from the Permian of Kansas.

Mineralogy. The Wheatley collection of about 4000 specimens of general distribution; small collections aggregating 500 specimens from different parts of the United States.

Historic geology and lithology. 1500 specimens from various localities.

Zoology. 14,177 specimens: species, 25 mammals; 300 birds; 100 reptiles; 20 amphibians; 150 fishes; 50 alcoholic examples of mollusks; the Webster collection of worms, 1950 specimens; 375 insects; 400 crustaceans; 352 echinoderms; 125 corals; 60 sponges; 2270 mollusks and molluscoids; the Wheatley collection of shells, numbering 8000 specimens.

Botany. 10,000 specimens, many exotic, arranged according to Engler & Prantl's *Pflanzenfamilien*. The local collections are very complete, specially the ferns and their allies of Schenectady county. There is also a valuable collection, 2300 specimens of fungi, the gift of Mr J. B. Ellis.

University of Rochester, Rochester. H. L. Fairchild, *curator of geology*; Charles Wright Dodge, *curator of zoology*.

Paleontology. The collection contains about 8000 species of European fossils besides those from America, altogether represented by about 25,000 specimens. It is particularly rich in ammonites and Tertiary mollusks.

On top of the paleontologic cases, and on the walls above them, is a series of models representing in facsimile many of the most celebrated fossils. There are also a number of casts, including a megatherium, three species of Proboscidea, an armadillo, and

a colossal turtle; specimens of the cranium and tusks of *Elephas ganesa*, the skull of a mastodon, and skull of *Dinotherium*.

Mineralogy. 5000 specimens, classified and consecutively numbered according to Dana's *System of mineralogy*, representing a great majority of known mineral species, showing crystalline and amorphous forms of the mineral. The specimens are largely from European localities—the rich mining regions of Cornwall, Saxony and Hungary having furnished many of the choicest masses of ores and most brilliant crystals. Among the largest groups are the fluorites, the quartzes and the calcites. There are also special collections in illustration of crystallography and other structural and physical properties of minerals.

Economic geology. A new department, and divided into carbon minerals, ores, and building and ornamental stones.

Phenomenal geology. A large variety of material illustrating the phenomena of rock structure and formation, and many interesting points in dynamic and physical geology. Here are huge columns of basalt from the Giant's Causeway, and the Rhine valley; volcanic bombs from the extinct volcanos of central France; veins of the several kinds in larger rock masses; contorted and folded strata; metamorphosed rocks; jointed structure; "slickensides"; faults; flexible sandstone; glaciated rocks; rounded drift; ripple marks; impressions of rain drops; mud cracks, etc.; a large number of septaria, clay stones and other concretions.

Lithology. 3000 specimens classified according to Dana's *Manual of mineralogy and petrography*.

A large number of the specimens were collected by Prof. Ward from the localities where specific rocks were first described. Disposed in the drawers are special collections representing the geology of characteristic regions; among these are 150 specimens from Vesuvius, once in d'Archaic's cabinet, 180 from Tuscany, 100 from Mt Blanc, 120 from the Paris Basin, 80 from Saxony, 200 from central France, and several hundred collected by the state geological survey, representing the New York strata.

Zoology. 1000 specimens: considerable invertebrate material; South American mammals and birds; native fauna, and many typical forms of vertebrates in general.

Botany. The collection is for teaching rather than for illustrative purposes and consists largely of algae and fungi.

Ethnology. Considerable material not on exhibition, and not fully classified.

The museum includes the Ward collections in mineralogy, lithology, paleontology and phenomenal geology. These are the original collections of Prof. Henry A. Ward, and were accumulated by him through many years of labor and extensive travel in execution of a plan to create a complete museum of geology for use in teaching. The material thus successfully gathered was purchased in 1862 for the university, through the generosity of the citizens of Rochester, for the low price of \$20,000. At that time it was the largest and choicest geologic collection in America, including about 40,000 specimens, handsomely mounted and labeled, and probably remains today unsurpassed in proportion and quality by any similar collection.

This museum is open to the public, and offers to the people and the schools of western New York an exceptional opportunity for the study of the earth's structure and history.

Vassar college museum, Poughkeepsie. William B. Dwight, *curator*, in charge of museum.

Paleontology. 8150 specimens consisting of a general collection of 5000 specimens, including the skeleton of a mastodon, 9 feet high and 21 feet long over all, a skeleton of a moa; lecture room collection always accessible for study to students of the geologic classes; the Hall collection no. 3, with some subsequent additions, about 3000 specimens. In the general collection, the Carboniferous and the strata above it are represented the more fully, chiefly by European specimens. In the lecture room collection the representation is fairly equal for the various strata in that part of it covered by the original Hall collection. Among the recent additions are about 100 fine sections of American fossil Bryozoa, accompanied by a specimen of each species prepared by E. O. Ulrich and a set of about 50 species of fossil ostracoid Entomostraca.

Mineralogy. About 3000 specimens in the general collection representing about equally the principal groups of minerals, purchased soon after the founding of the college from Ward's establishment, together with more recent additions; also a lecture room collection of 500 specimens always accessible to students in mineralogy. The ores and varieties of quartz are the more fully represented; there are also a large number of specimens of small size illustrating various crystalline forms; there are sets representing the various varieties of physical properties in minerals, and full sets of glass and wooden models of crystal forms.

Lithology. 800 specimens of rocks, including a selected representative collection of 150 typical rocks donated by the United States geological survey. There are about 100 microscopic sections of different kinds of rocks.

Zoology. 25,090 specimens including Foraminifera, plaster models, 150; Foraminifera, actual models, 200; sponges, 100; corals, 400; echinoderms and crinoids, 300; mollusks, chiefly shells, 18,000; crustaceans, 300; insects, 600; fishes, batrachians and reptiles, 40; birds, mounted and skins, 2600; birds eggs, 800; birds nests, 150; mammals, 100; osteologic specimens and various models, 400; alcoholic specimens (miscellaneous), 800; zoologic microscopic slides, 200.

Botany. 1700 specimens including the Merrill collection of ferns (pressed), 1000 specimens; a collection of ferns from the Hawaiian islands, 100 specimens; a general herbarium, 1500 specimens; 100 specimens of plants in many cases with open flowers, finely preserved in alcohol.

An adjunct to the museum is the Eleanor conservatory, containing many valuable plants (at least 1500) representative of the leading families, with facilities for their study.

Ethnology and anthropology. About 770 specimens, including arrowheads from many of our states, 350 specimens; Erminie A. Smith collection of ethnologic specimens of the Zuni Indians, 200; Orton collection of South American ethnologic and archeologic specimens, including valuable pottery, an ancient Peruvian mummy and a very rare compressed human head from the

Amazon river, 120; other miscellaneous archeologic and ethnologic specimens, 100.

Specially valuable specimens are, the type specimens of Trudeau's tern; several birds collected by Audubon, one of which, the great auk, the rarest of birds, was the original of his great steel plate engraving of the auk; a male specimen of the Labrador duck; several characteristic and finely mounted bird groups; a very large collection of South American humming birds; two condors, one reputed to be the largest in the country; a fine pair of California vultures; several ivory-billed woodpeckers; two male resplendent trogons; a moa skeleton; a mounted gorilla of great size and a skeleton of a gorilla; a fine narwhal tusk; a mammoth tusk and scapula; a mastodon skeleton; a fine group of the fur seal, male, female and pup from the Pribyloff islands; a mounted tarpon; a plaster cast of an immense fossil armadillo (*Schistopleurum*); 3 skulls of *Titanotherium* from Nebraska; a complete series of teeth in jaws of fossil horses illustrative of the evolution of that animal from the lower Eocene to the Pleistocene, donated by Prof. H. F. Osborn; a series of paleontologic casts of vertebrates, prepared at the American museum of natural history; a remarkably perfect and fairly complete specimen of the mosasaur *Clidastes velox*, on a single slab of stone, 8 feet long, from the Cretaceous of Kansas; a set of 100 microscopic sections of bryozoans with accompanying specimens, prepared by E. O. Ulrich; a large set of Ziegler's embryologic models; a complete set of Reeve's *Iconica Conchologica*, and many other valuable conchological works, purchased with Witthaus's large and fine collection of molluscan shells and kept with them in the museum.

An annual fund of not less than \$850, \$100 of which comes from a legacy of J. P. Giraud jr and the balance from a fund established by the founder, Mr Vassar, is available for the purchase of new specimens.

Ward's natural science establishment (a commercial museum) Rochester. Frank A. Ward, *secretary and treasurer*; E. T. Iekes and H. L. Preston, in charge of the inorganic department; also a staff of 16 assistants in the various departments. This company is incorporated under the laws of New York, with a capital

of \$125,000. The object is "collecting, preparing, manufacturing and dealing in objects of natural history."

Paleontology. 150,000 specimens representing all the geologic periods, and from all parts of the world; 1024 casts of celebrated fossils, most of the originals of which are in the various royal museums of Europe; and 100 different models and charts.

Mineralogy. 160,000 specimens of minerals from all parts of the world; a collection of meteorites containing over 200 falls and more than 350 specimens; series of specimens illustrating systematic mineralogy, physical mineralogy, crystallography, etc.

Historic geology and lithology. 22,000 specimens, including series illustrating general petrology and physical, dynamic and stratigraphic geology; a special series of about 125 specimens from the typical localities of the New York formations; 26 relief maps and models (geologic and topographic) of the most interesting geologic regions of the United States and abroad; several models illustrating dynamic and structural geology.

Zoology. 137,000 specimens: mounted specimens, skins and skeletons of mammals, birds, reptiles, batrachians, and fishes; also human skeletons and many anatomic models, charts and diagrams for use in instructing classes; a general collection in invertebrate zoology of 125,000 specimens representing 3000 species; and a special collection of 750 specimens of sponges containing many unique and undescribed forms.

Botany. 74 models illustrating the anatomy of plants.

Ethnology and anthropology. 5826 specimens of articles of war, use, ceremony and adornment of ancient and modern races from all parts of the world; also a large series of mummies and aboriginal skulls and skeletons.

All specimens in the establishment are for sale.

West Point mineralogical and geological cabinet. Samuel E. Tillman, in charge of the museum, assisted by Capt. R. P. Davis, artillery corps, and Capt. S. G. Jones, 11th cavalry.

Paleontology. 9074 specimens. A fairly representative assortment of the various forms of invertebrates from the Cambrian to the present time. A good collection of the fossils from the Carboniferous. A fine collection of the Mesozoic and Tertiary

mollusks, originally exhibited at the Crystal palace exhibition in 1851, and afterward bought for the military academy. The collection of recent mollusks is quite full and the collection of modern corals, fair.

In the Mesozoic collection there are 112 fossil forms from the Solenhofen limestone, and 200 plant leaves from the Dakota Cretaceous, both typical and excellent.

Mineralogy. 4563 specimens. A fairly full assortment of the ores of the common metals, of the varieties of silica (quartz) and the various silicates and calcareous minerals—no particular locality. Groups best represented are the ores of the metals and quartz.

Lithology. 644 specimens. Nearly all the species of the plutonic, metamorphic and volcanic rocks, together with many of the sedimentary rocks, including some fine marbles. A fine collection of the rocks of New England (250 specimens). An educational series of rocks from the United States geological survey, (156 specimens).

Ethnology and anthropology. Small number of implements of the Stone Age, and a small number of specimens of Indian pottery (Pueblo).

The museum also contains about 1200 unique or rare minerals, rocks and fossils not mentioned above including some large ammonites in section; some fine specimens of elephants' and mastodons' teeth, (Quaternary); a vertical section of the Coal Measures of Pennsylvania, with description; a vertical section of the Pennsylvania oil sands, with specimens of the sands and oils from different levels; plaster cast of American continents, with parts of Europe and Africa, and the bed of the Atlantic ocean; three exhibit collections of minerals, rocks and fossils for daily section room use, 1000 specimens each; a working collection of minerals, rocks and fossils for the same purpose, of 45,000 specimens (estimated from partial count). The cabinet also contains a set of crystal models, in glass and pasteboard (150).

NORTH CAROLINA

Davidson college museum, Davidson. J. M. Douglas in charge.

Paleontology. 3000 specimens. Paleozoic time is best represented, specially the Carboniferous system.

Mineralogy. 4000 specimens including the Brumley cabinet and the Oglethorpe university collection.

Historic geology and lithology. 2500 specimens particularly representative of the recent rocks.

Zoology. 800 specimens of shells.

North Carolina state museum, Raleigh. H. H. Brimley, *curator*; J. A. Holmes, *state geologist*; and T. K. Bruner, *secretary*.

Paleontology. Remains of marine and land vertebrates, including such striking forms as the mastodon, whales, sharks and other interesting forms, reptiles being particularly well represented.

Mineralogy. A systematic series of all the mineral species found in the state; a collection in crystallography; gem material and a very valuable collection of cut gems, including a specimen of diamond from Burke county; other native gems as ruby, sapphire, oriental topaz, cat's-eye, rhodolite, garnets, emerald, aquamarine, golden and opaque beryl; a lot of the semiprecious stones, and a small collection of meteorites.

Lithology. 500 specimens of the rocks of the state, arranged alphabetically by counties; 1000 specimens of rocks from which sections have been cut and samples analyzed.

Economic geology. A complete collection of the iron ores of the state, magnetite, hematite, limonite, siderite, pyrite; an exhaustive collection of gold, silver and copper ores in very wide variety; very full series of corundums and micas, talc, kaolins and other clays; granites, marbles and sandstones in systematic series showing both the finished and raw product; millstones; monazites in great variety, and zircons.

Zoology. The fauna of the state is well shown; a fairly complete series of the more conspicuous vertebrate forms including a 45 foot skeleton of *Balaena biscayensis*; fur-bearing animals; game birds and animals; birds eggs; a large series of reptiles and fishes; a full collection of economic fishes,

mounted and a fairly complete representation of the marine invertebrate fauna of the state.

Botany and forestry. A collection of about four hundred specimens of officinal plants of the state. In economic series are shown the timber trees of the state in finished and rough condition, illustrated profusely by enlarged photographs, also tree sections showing normal and abnormal growth.

Ethnology. A few cases of stone implements and pottery, and some human remains include the bulk shown. Considerable additions are in prospect in the near future.

This museum is an exhibit of the natural resources of North Carolina only. No effort is made to secure anything else, and the few outside specimens listed have been acquired incidentally. Plenty of room is given everything, and the cases are of the best known types for exhibiting the classes of specimens they contain. The capacity of the museum has been doubled at this date, three large exhibition halls having recently been completed. These will be filled along the lines mentioned. About 35,000 feet of floor space are occupied.

University of North Carolina, Chapel hill. No report.

NORTH DAKOTA

North Dakota agricultural college museum, Fargo. C. H. Hall, *professor of geology*, assisted by J. H. Shepperd, H. L. Bolley and E. F. Ladd.

Paleontology. A representative collection of fossils from Cambrian to Tertiary. Petrified wood and diatomaceous earth for exchange.

Mineralogy. 1000 labeled specimens.

Historic geology. A large collection specially illustrative of glacial phenomena with numerous models and charts.

Zoology. 150 well mounted birds of the northwest; 200 specimens of reptiles and fishes and other animal specimens for class reference, including quite an extensive display of bones illustrating the osteology of certain diseases in the horse.

Botany. An extensive herbarium of native plants of North Dakota; a full collection of the cultivated and native grasses of the state exhibited in large bunches for display of the roots, leaves, stems and fruit.

Material for exchange includes many species of the native plants and nearly complete series of the grasses of the state, mounted on herbarium sheets, or in bunches.

Ethnology. 50 relics of the American Indians; large collection of continental and other moneys.

Red River Valley university museum, Wahpeton. Edward P. Robertson, *president of the university*, in charge.

Paleontology. A few hundred specimens: series of fossils from the Silurian formations of New York; from the Carboniferous formations of Pennsylvania; and from the drift of North Dakota.

Mineralogy. Collection small and of general distribution.

Historic geology and lithology. A few hundred specimens illustrating various geologic formations: the lignite beds of North Dakota; the Ortonville syenite; and the geology of the Bad Lands of North Dakota.

Zoology. 100 specimens representing the classes of birds, reptiles, insects, etc.

Botany. 200 specimens illustrating the local flora. The herbarium is the result of field work of the botany class, and of private study.

Ethnology. 500 specimens confined to relics of the American Indians: some Arickaree pottery from the banks of the Missouri river; gleanings from various Sioux village sites; and some specially fine large milling stones, used by the Indians in making pemican.

State university of North Dakota museum, Grand Forks. M. A. Brannon, *department of biology*, and E. J. Babcock, *department of chemistry and geology*, in charge.

Paleontology. 1000 specimens, representing fossils of the various formations from the Cambrian upward, specially the Cretaceous, Laramie and Tertiary formations. Some material for exchange.

Mineralogy. 2000 specimens of wide distribution. The Black Hills of South Dakota is the district best represented. Large variety of clays of economic value and lignite coals for exchange.

Economic geology. 800 specimens, including clays and clay products of various kinds, coals, sandstones and soils.

Zoology. 299 specimens: 12 mammals; 7 skeletons of mammals; 120 birds; 40 fishes; 10 reptiles; 10 amphibians; 100 invertebrates. 30 duplicate specimens of birds for exchange.

Botany. 4640 specimens: herbariums of 1200 species of phanerogams; 100 species of fungi; 340 species of algae.

1000 duplicate phanerogams for exchange.

Ethnology. 650 specimens: 200 of weapons and wearing apparel of the American Indians; 15 of Mexican and oriental wearing apparel and ornaments; and 300 foreign and domestic coins. Few duplicates for exchange.

OHIO

Antioch college, Yellow Springs. W. E. Wells, *professor of biology*, in charge.

Paleontology. 10,000 specimens: 300 graptolites, from England, United States and Germany; 5000 specimens, United States Silurian; 1000 Devonian; 500 Carboniferous; 1000 of later formations.

Mineralogy. 500 specimens; educational collection of United States geological survey and some others; no one locality well represented.

Historic and economic geology and lithology. Silurian, Devonian and Carboniferous fauna; metalliferous and nonmetalliferous ores and their products; common rock-forming elements and compounds; fairly good series of rocks of earth crust.

Zoology. 4000 specimens: two mounted mammals; a few poorly mounted skeletons; eggs; common invertebrates for class demonstration; 500 insects, unarranged; 3000 shells, unnamed.

Botany. 600 specimens: several hundred sheets of pressed plants from this locality, gathered by students; small collection of mosses.

Ethnology and anthropology. 20 specimens: pottery of the Mound Builders and several human skeletons and remains without date, obtained from small caves along the cliffs of the Little Miami river.

Baldwin university museum, Berea. A. G. Rääb, *professor of natural science*, in charge.

Paleontology. 300 specimens, mostly Devonian and Carboniferous.

Mineralogy and geology. 500 specimens, including a general collection from the United States geological survey; specimens of the Berea, Cuyahoga and Bedford shales, mostly local, also specimens of the Berea grit with its numerous ripple markings. Could exchange specimens showing ripple markings, also cone-in-cone.

Historic and economic geology. Collections very small.

Zoology. 300 specimens mostly invertebrates.

Botany. Few specimens.

Case school of applied science, Cleveland. Frank M. Comstock, professor of natural history.

Paleontology. 7000 specimens: stratigraphic specimens, 576; zoologic, 1424; miscellaneous and unclassified material, 5000. Duplicates for exchange.

Mineralogy. 3000 specimens devoted to purposes of teaching, and not particularly complete in any group.

Historic and economic geology and lithology. 1854 specimens: illustrative of stratigraphic geology, 250 specimens; geologic phenomena, 200; an economic collection of 700; a collection of 800 illustrating the lithologic character of rock. Some duplicate material for exchange.

Zoology. 9651 specimens (3400 catalogued numbers): mammals, 80 mounted specimens; alcoholic specimens, 19; miscellaneous, 23; birds, 350 mounted specimens, 492 skins, and 630 nests and eggs; reptiles and batrachians, 229 alcoholic specimens; fishes, 224 alcoholic specimens; mollusks, 715 species in alcohol; Arthropoda, 380 species in alcohol; other invertebrates, 276 species in alcohol.

The above are catalogue numbers and include in many cases several specimens under one number. Duplicates for exchange.

Botany. 2724 varieties, illustrated by 3719 mounted specimens chiefly of the flora of Ohio. 1000 duplicate specimens, and exchange material.

Cincinnati society of natural history, Cincinnati. Joshua Lindahl, director.

Paleontology. 4882 specimens: a large general collection of fossils from North America and Europe; a practically complete collection of the fossils of the vicinity of Cincinnati; the Paul

Mohr collection of fossils, the greater part of which is not on exhibition on account of lack of space; and the most perfect pair of cores of horns of *Bison latifrons* in existence.

Mineralogy. 1296 specimens of general distribution.

Lithology. 734 specimens.

Zoology. Mammals, 150 species; including 37 species of *Quadrumanus*; birds, 450 species, 1450 specimens, 220 sets of eggs, and 102 nests. Reptiles 103 species viz: *Ophidia* 43, *Lacertilia* 26, *Chelonia* 31, *Crocodylia* 3, and *Batrachia caudate* 35 species, 627 specimens, other batrachians not indexed. Fishes 391 species. Mollusca about 3000 species, of which only the *Naiades* have as yet been completely indexed 389 species, recognized in Simpson's *Synopsis*, 1497 catalogue entries. The balance of the collection, though mostly classified and much of it displayed in glass cases, has not as yet been indexed.

Botany. A mounted herbarium containing about 4000 species, an unassorted collection of about 10,000 unmounted specimens of woods, nuts, cones, etc.

Ethnology. The ethnologic collections of the society have, for lack of space in the museum, been deposited for the present time in the art museum in Eden park, with the only exception of the prehistoric Indian relics from the Cincinnati region. Of these there are 122 skulls, and two large cases filled with specimens from the so-called "prehistoric cemetery" at Madisonville, Hamilton county, just outside the city limits of Cincinnati.

Cuvier club of Cincinnati, Cincinnati. Charles Dury, *custodian of the collections.*

An organization for the protection of fish and game. The society possesses collections of birds and fishes, chiefly of the local fauna, and a library devoted to these subjects.

Heidelberg university, Tiffin. M. E. Kleckner, *professor of geology and biology, and acting professor of chemistry and physics.*

Paleontology. Material from the Silurian. Some specially fine cephalopods, Devonian, Carboniferous, Cretaceous, Tertiary and Quaternary systems; 100 plaster casts of fossils, including a megatherium and a mastodon skull.

Mineralogy. A fair presentation of the science.

Economic geology. 500 specimens: important varieties of ores, iron, copper, lead, zinc, gold, silver and antimony.

Zoology. 100 well mounted mammals and birds. Marine and fresh-water shells.

Ethnology. A few relics of the American Indians and the Mound Builders.

Hiram college museum, Hiram. George H. Colton, *professor of natural science.*

Paleontology. 1000 specimens: Paleozoic time is the best represented, but there is some material of later age.

Mineralogy. 1200 specimens: the more common minerals and ores from various localities.

Economic geology. 100 specimens: collections of building stones and fire clays.

Zoology. 1000 specimens: a collection of birds; shells from the Hawaiian islands.

Botany. A small herbarium and a small number of woods.

Ethnology. 2000 specimens: Indian relics from the neighborhood; some implements, war clubs, etc. from the South Sea islands.

Oberlin college museum, Oberlin. Albert A. Wright, *curator*, Lynds Jones, *assistant curator.*

Paleontology. 5700 trays of specimens, each containing from 1 to 50 individual specimens. This includes 4000 trays of Paleozoic fossils, one half of which are from the Carboniferous formations; a fine series of fossil fishes from the Upper Devonian formations, including type specimens of *Mylostoma*, *Titanichthys*, *Dinichthys*, etc.; numerous bones of *Camarasaurus supremus* Cope, from Canyon City Col.; a mastodon skull and tusks from Loraine county, O.; a series of 400 trays of Mesozoic fossils; 650 trays of Tertiary forms; and 300 of Pleistocene fossils from southern California.

Mineralogy. 2950 trays of specimens of general distribution; also a set of 900 trays for laboratory use.

Historic geology. General series of 1500 trays of specimens; a series of 2200 trays illustrating geologic phenomena.

Economic geology. 800 trays.

Lithology. 1200 trays of specimens; 4000 trays illustrating the varieties of rocks that are represented by the glacial boulders of the vicinity; a set of 300 glacial boulders approximately matched with the Ohio and Canadian rocks from which they were derived.

Zoology. 20,000 specimens: 60 mounted skins of mammals; 600 mounted skins of birds, and 1500 unmounted; 150 varieties of birds eggs in sets; 230 mounted and alcoholic specimens of reptiles; a complete set of the local fishes, 89 species, and a general collection of 580 mounted and alcoholic examples of fishes; 50 mounted skeletons and skulls of vertebrates; 5000 mounted insects; 4000 species of mollusks and other shells; and many hundreds of specimens of other invertebrates. Duplicates for exchange, particularly in the conchological collection.

Botany. 35,000 specimens: 15,000 specimens of phanerogams; 5000 of fungi; and an extensive series of United States lichens, mosses and algae. 15,000 duplicates for exchange.

Ethnology. 3500 specimens: representative collections of Japanese armor, weapons, apparel, etc.; Siamese utensils and apparel; weapons and apparel of the Dakota Indians; 45 specimens of Eskimo implements; Pacific islanders arms, utensils, mats, and apparel; south African weapons, apparel, and utensils; and a very complete collection (2000 specimens) of relics of the American Indians from both the east and west coasts of the United States. Several hundred articles from southeast Africa for exchange.

There are also in the museum various collections of historic interest.

Ohio state university museums, Columbus. J. A. Bownocker, *curator of geologic museum*; Herbert Osborn, *curator of zoologic and entomologic museums*; James S. Hine, *assistant in charge of zoologic and entomologic museum*; W. A. Kellerman, *curator of botanical museum*; W. O. Mills, *curator and librarian of archeologic museum*; Pearl Contillier, *assistant in archeologic museum*.

Paleontology. 9000 specimens; the formations best represented are the Hudson, Niagara, Corniferous and Coal Measures; valuable collections of fishes from the Corniferous limestone and Ohio shales; the collection is also rich in Coal Measures flora.

Much material for exchange from the Hudson, Niagara, Corniferous and Coal Measures.

Mineralogy. 500 specimens.

Economic geology and lithology. The economic museum contains about 2000 specimens illustrating Ohio material; in lithology there are about 500 specimens, including the Hawes collection from New Hampshire; the Williams collection from Baltimore; the Rohn collection from Lake Superior and the Krantz and Rosenbusch collections from Europe. Besides these the museum contains the Voigt and Hochgesang collections of thin sections of minerals and rocks.

Iron ores, building stones, coals and crude oils from Ohio for exchange.

Zoology. 25 mounted and 50 alcoholic specimens of mammals; 250 mounted specimens and 2500 skins of birds, mostly from North America; 100 jars of reptiles, 45 jars of batrachians, 289 jars of fishes, 96 jars of invertebrates, 300 skeletons, skulls and anatomic preparations; 3500 specimens of mollusks; and about 40,000 specimens of insects. Total number about 50,000 specimens. The Ohio fauna is well represented throughout the collection.

Entomologic specimens for exchange.

Botany. 3000 museum specimens, 80,000 herbarium specimens: a general herbarium of 30,000 mounted sheets; state herbarium of 20,000 mounted sheets of spermatophytes and pteridophytes; about 10,000 bryophytes and thallophytes; the W. A. Kellerman herbarium of 20,000 parasitic fungi; a museum consisting of 3000 specimens of 1) native trees of Ohio shown by sections of trunks, bark, slabs of wood, polished wood, twigs, leaves, flowers and fruit; 2) wood panels; 3) economic products; 4) medicinal plants of Ohio; 5) miscellaneous specimens.

Some herbarium specimens for exchange, principally fungi.

Ethnology and anthropology. 100,000 specimens representing archeologic material from every county in the state.

Archeologic material for exchange.

The museum also contains specimens of books printed in Ohio; specimens illustrating the settlement of Ohio and the Northwest territory.

All specimens collected by the geologic survey of Ohio are required by law to be placed in the charge of the state university.

Ohio Wesleyan university, Delaware. Edward L. Rice, *curator and in charge of collections of zoology and anthropology*; Lewis G. Westgate, *professor of geology, in charge of collections of geology, mineralogy, paleontology and botany.*

Paleontology. 5000 specimens including casts; the Devonian and Silurian formations are best represented; some good Devonian fishes; collection of 1000 Ward casts.

Mineralogy. About 2000 specimens.

Economic geology and lithology. About 1000 specimens.

Zoology. General collection, corals specially well represented; about 20,000 specimens of Mollusca, 500 of which are Unionidae. Total number of specimens 25,000.

Botany. About 300 specimens of woods.

Ethnology and anthropology. About 1200 specimens, mainly North American stone implements; including 500 choice and well selected specimens of the William Walker collection.

Lantern slides of geographic and geologic subjects and Ohio Corniferous fossils, specially corals, for exchange.

Otterbein university, Westerville. W. C. Whitney, *professor of biology and geology*, in charge.

Small working collections, of direct use in teaching, in nearly all lines but not for display.

Scio college, Scio. J. H. Beal in charge.

Mineralogy. 2000 to 3000 specimens.

Historic and economic geology and lithology. 500 to 800 specimens.

Zoology. 150 specimens.

Botany. 800 to 1000 specimens of American plants and woods.

Ethnology and anthropology. Small collection.

Specimens are distributed throughout the departments and in care of instructors using same.

University of Wooster, Wooster. No report.

Urbana university museum, Urbana. John H. Williams, *dean.*

Good general collections but not at present on exhibition.

Western Reserve University, Cleveland. F. H. Herrick, *curator of biology*; H. P. Cushing, *curator of geology*.

Paleontology. 6000 specimens: the S. G. Williams collection, mainly of New York Paleozoic, 2500; various small gifts and purchases; Silurian, Devonian and Eo-Carboniferous best represented.

Mineralogy. 2500 specimens: a very old collection obtained by purchase and by donations of Dr Kirtland and Col. Whittlesey; small and scattering recent additions.

Lithology. 1200 specimens mostly igneous rocks.

Zoology. 10,000 specimens: the R. K. Winslow collection of birds; the Kirtland society of natural history collection; private collection of the late Dr J. P. Kirtland; the general collection of Western Reserve university.

Botany. 1000 specimens: fairly complete collection of the Ohio flora.

OKLAHOMA

University of Oklahoma, Norman. Charles N. Gould, *curator*. Museum collections destroyed by fire January 1902, new material is now being secured.

OREGON

Oregon state agricultural college museum, Corvallis. A. B. Cordley, *professor of zoology*, in charge of museum; W. T. Shaw, *assistant*.

Mineralogy. 1000 specimens.

Zoology. Small collection of Oregon mammals, Oregon birds and marine invertebrates.

Entomology. 75,000 specimens of Oregon insects, mostly Lepidoptera, Coleoptera, Hymenoptera, Diptera and Hemiptera.

Specimens of Coleoptera, Hemiptera, Diptera and Hymenoptera for exchange.

Botany. 8000 to 10,000 specimens of phanerogams and vascular cryptogams. 10,000 to 15,000 unclassified specimens. About 500 fungi, etc. About 10,000 to 15,000 specimens of Oregon and Washington phanerogams and vascular cryptogams for exchange.

Portland university, Portland. No report.

University of Oregon, Condon museum, Eugene. Thomas Condon, *professor of geology*; Chester Washburn, *assistant*.

Paleontology. 6000 specimens: the collection is principally Oregon material, it contains 500 specimens from the marine Tertiary of Oregon and the largest collection which has been made of Tertiary vertebrates from the John Day beds and other deposits of Eastern Oregon and type specimens including *Unio condoni* White, *Scalaria condoni* Dall, *Platygonus condoni* Marsh, *Anchitherium condoni* Leidy, *Oreodon superbus* Leidy, *Hippa eocensis* Washburn, *Hippa miocensis* Washburn.

Mineralogy. 800 specimens, general collection.

Economic geology and lithology. 900 specimens: collection of Oregon building and ornamental stones; ores of the Pacific Coast; metamorphic and igneous rocks of Oregon. Some material for exchange.

Zoology. 1000 specimens, collection of flowering plants and a private collection of fungi. A collection of Oregon woods for furniture, cabinet-making, etc.

Ethnology. 325 specimens, implements, etc., of Oregon Indian tribes.

Williamette university, Salem. No report.

PENNSYLVANIA

Academy of natural sciences of Philadelphia, including collections of the second geological survey of Pennsylvania, Philadelphia. Samuel G. Dixon *president*; Samuel G. Dixon, Henry C. Chapman, Henry A. Pilsbry, and Arthur Erwin Brown, *board of curators*; Witmer Stone, *assistant curator*; David McCadden, *taxidermist*; F. W. Wamsley, *preparator of marine animals*; Stewardson Brown, *conservator of botanic section*; Henry Skinner, *conservator of entomologic section*; H. A. Pilsbry, *special curator of conchology*; Witmer Stone, *ornithologic section*; Theodore D. Rand, *curator of the Vaux collection of minerals*; Rev. L. T. Chamberlain, *curator of the Lea collection of Eocene fossils*.

Paleontology. 45,000 specimens: the Lea collection of Eocene fossils, containing many type specimens described by Lea; the

Joseph Wilcox collection of Pliocene fossils; the Conrad and Gabb collections, containing many of Conrad's type specimens; an extensive collection of vertebrate fossils, among which are many of the types described by Cope and Leidy.

Mineralogy. 16,000 trays of specimens: large general collection; the William S. Vaux collection, specially endowed and constantly increasing—most of the specimens being exceptionally fine.

Historic geology and lithology. Several thousand specimens not at present arranged for exhibition.

Zoology. 1,059,400 specimens: 9000 mammals, representing species from all parts of the world, including mounted and unmounted skins and skeletons; one of the finest collections of birds in America, numbering 46,000 specimens; mounted and unmounted skins, including the type specimens described in Gould's *Birds of Australia*, as well as many described by Cassin, Townsend and others; 4400 jars of reptiles, including many type specimens described by Cope; 4000 specimen jars of fishes from all regions, including the Bonaparte collection; 850,000 specimens of mollusks, forming the largest collection in America, and including many type specimens described by Tryon, Lea, Say, Pilsbry, and others; 126,000 insects, including the Martindale collection of Lepidoptera; and the George H. Horn collection of Coleoptera. 20,000 specimens of other invertebrates, specially of crustaceans and echinoderms.

Botany. 200,000 specimens representing 40,000 species: collections of Nuttall, Read, Buchley, LeConte, Shortt and others; most of the series made by recent collectors in America; very large herbarium of old world plants; the Ellis and Everhart collection of fungi; the George A. Rex collection of Myxomycetes.

Ethnology. 10,000 specimens: a general collection; the Clarence B. Moore relics of the Florida and Georgia mound Indians; the Peary relief expedition collection from Greenland; the Halde-man remains of North America Indians and native tribes of British Guiana; and the Morton collection of crania numbering 1100 specimens.

Exchanges made in all departments.

One room of the museum is devoted to the natural history of eastern Pennsylvania and New Jersey, and contains collections

in all departments of zoology, geology and mineralogy; also the Delaware valley ornithological club's collection of birds of that region, mounted with their nests and eggs, which attracts special attention.

Albright college, Myerstown. J. B. Stober, *professor of natural sciences and chemistry*, in charge of all collections, except those in anthropology, which are in charge of A. E. Gobble, *president*.

Paleontology. 700 specimens, chiefly from the Paleozoic formations.

Mineralogy. 775 specimens, including some typical specimens of silicates.

Geology. Iron ores from the state; a collection illustrating primordial metamorphism.

Zoology. 1300 specimens: marine invertebrates donated by the Smithsonian institution; recent shells and corals; labeled collection of fresh-water and marine fish; mounted specimens of the higher orders; and materials for class use in dissection and in lectures on comparative anatomy.

Botany. 500 specimens. 125 duplicates for exchange.

Ethnology. 300 specimens: historic relics, ancient and modern, coins; and relics of the American Indians.

Alleghany college, Meadville. J. H. Montgomery, *curator*.

Paleontology. Many specimens and a collection of Ward casts.

Mineralogy. About 10,000 specimens consisting of the Alger collection; the Prescott collection; and the Haldeman collection.

Historic and economic geology and lithology. Small collection, part of which was furnished by the United States national museum.

Zoology. About 100 mounted birds, a few specimens of animals in alcohol and 20 miscellaneous specimens mounted and unmounted. One fine mounted specimen of moose from Maine, the Prescott collection of shells, 5000 in number; also a set of shells from United States national museum.

Botany. Collection of local plants.

Ethnology and anthropology. About 100 specimens.

Boys central high school, Philadelphia. No report.

Bryn Mawr college, Bryn Mawr. Florence Bascom, *professor of geology*, in charge.

Paleontology. 700 species illustrated by 3500 specimens; chiefly invertebrate fossils, selected to cover geologic time from the Cambrian to recent, the Miocene species being the best represented.

Mineralogy. 950 specimens best representing Pennsylvania localities.

Lithology. 86 specimens and slides illustrating the geology of the Lake Superior region.

156 specimens and slides of the educational series of the United States geological survey, 14 specimens of the igneous rocks of Arkansas; 150 specimens from the Boston Basin and the Yellowstone national park; 60 specimens and slides from the Blanc massif, 100 specimens of eruptive rocks from the neighborhood of Christiania, Norway; 180 slides of the Rosenbusch igneous series; 28 specimens and slides of the Rosenbusch crystalline schist series and a full suite of the metamorphic rocks of Pennsylvania and Maryland.

Miss Bascom's private collection of 1450 specimens and 500 microscope slides illustrating foreign and American geology is accessible to students.

There are also biologic and ornithologic collections belonging to the college.

Bucknell college, Lewisburg. No report.

Carnegie museum, Schenley park, Pittsburg. W. J. Holland, *director*; staff includes 20 persons.

Paleontology. Large collections of vertebrate fossils made in Colorado, Wyoming, Nebraska and Montana. Specially rich in Dinosauria. Many types of species recently discovered. The best specimens of *Diplodocus* and *Brontasaurus* in existence. Large collections of invertebrates and fossil plants.

Mineralogy. 7000 specimens representing about 500 species.

Historic and economic geology and lithology. Considerable collections obtained by staff of museum and by purchase.

Zoology. 850,000 specimens. Mammals 550 species; birds 3000 species; fishes 300 species; reptiles 250 species; crustaceans 150 species; insects 72,000 species; mollusks 15,500 species;

marine invertebrates 420 species; about 45,000 species represented by types or paratypes.

Botany. 120,000 specimens representing 22,500 species. A fine series autographically labeled by the older American botanists.

Ethnology and anthropology. 6750 specimens. Collections representing the aboriginal tribes of North and South America, Africa and Asia and considerable collections from Egypt.

The museum publishes a series of octavo Annals and quarto Memoirs. Endowment, \$1,000,000.

Dickinson college, Carlisle. No report.

Geneva college museum, Beaverfalls.

Small general collection.

Haverford college museum, Haverford. H. S. Pratt, *professor of biology*, in charge.

Lithology. A small collection of rocks.

Zoology. 1075 native and foreign birds; 422 varieties of birds eggs; 4000 European beetles.

Botany. A collection of native and foreign plants.

Lafayette college, Easton. Frederick B. Peck, *professor of geology and mineralogy*, in charge.

Paleontology. A good working collection.

Mineralogy. 1000 specimens representative of the chief American and European localities. Minerals from Franklin Furnace N. J. for exchange.

Zoology. Fairly good representation of systematic zoology, together with a series of study collections for the use of students.

The museum was burned in 1898. New collections are now being made.

Botany. A large herbarium of the Pennsylvania flora, representing seven eighths of the North American species; many European, African, Indian, and Australian plants.

Lebanon Valley college, Annville. No report.

Lehigh university, South Bethlehem. See Addenda, p. 222.

Muhlenberg college, Allentown. W. R. Whitehouse in charge.

Paleontology. 600 specimens, representing the fauna of the various geologic periods.

Mineralogy. A general series of 500 representative specimens.

Lithology. 400 specimens: illustrative of the various formations of Pennsylvania; a partial series from Minnèsota.

Zoology. 500 specimens, representative of the principal divisions of invertebrates, with a very few vertebrates.

Botany. 3000 specimens, mostly from Lehigh county, with some material from other localities.

Pennsylvania college, Gettysburg. E. S. Breidenbaugh, *curator*.

Mineralogy. 6000 specimens, general, representing most of the mineral species, and including a number of excellent crystals; 500 specimens in iron, copper and zinc metallurgy.

Lithology. 3000 specimens illustrating the general features of rock structures.

Botany. 6000 specimens: a general herbarium of eastern United States flora; some few varieties from Brazil.

There are no ethnologic collections.

Pennsylvania geological survey, Harrisburg. Collections deposited in the Academy of natural sciences of Philadelphia.

Paleontology. 2128 fossil invertebrates from Pennsylvania, ranging from the Potsdam sandstone through the Carboniferous formations; 549 fossil plants collected by Leo Lesquereux to illustrate the paleobotany of the coal formations of the state; 1248 specimens from Perry county, collected by E. W. Claypole, including 30 type specimens of invertebrates; and 293 Waverly and Chemung fossils, collected by F. A. Randall in the vicinity of Warren.

Mineralogy. 135 specimens collected by F. A. Genth, mostly from the southeastern part of the state.

Historic geology and lithology. 10,000 specimens: separate collections from sections across various counties and other portions of the state made by the survey members and arranged for exhibition accordingly; 146 specimens of glacial erratics collected in the state by H. C. Lewis; 1127 specimens collected by John F. Carll from the oil region, including a valuable series of sand pumpings and an economic collection of samples of crude petroleum from the various wells.

Pennsylvania military college, Chester. No report.

Pennsylvania state college, State College. The collections are not united as a museum, but each technical department has a collection which is in charge of the head of the department. M. E. Wadsworth, *professor of mining and geology*; N. W. Shed, *assistant in mining and metallurgy*; W. A. Buckhout, *professor of botany*; H. A. Surface, *professor of zoology*; H. P. Armsby, *professor of agriculture*; and G. G. Pond, *professor of chemistry*.

Paleontology. 2000 specimens: the Ward collection representing all geologic formations; Corniferous fossils from Columbus O.; specimens from the Cincinnati group of southeastern Indiana, from the Niagara group of Waldron Ind. and from the Subcarboniferous limestone of Indiana; fossil leaves from the Cretaceous formations of Dakota; material from the Trenton and Hudson river groups about State College Pa., and from the Coal Measures of Alleghany Pa.

Mineralogy. 10,000 specimens: a large exhibition collection; a series illustrating physical properties, crystallization, etc., for the use of students.

Historic geology. A general stratigraphic series; the material collected by the first and second geologic surveys of Pennsylvania.

Lithology. A series of European rocks; rocks of the state; and a set of the United States geological survey collection of 200 rock types.

Economic geology. 5000 specimens: the Pennsylvania exhibit of ores, minerals and economic products at the World's Columbian exposition; a polyolith of 281 building stones of Pennsylvania and elsewhere; special collections of ores and ore-bearing rocks from Colorado and iron ores from the Lake Superior region; a general collection of economic minerals and rocks from Germany.

Zoology. 15,000 specimens: a general collection of 10,000 specimens; a special series of Pennsylvania vertebrates, a nearly complete representation; a special collection of insects showing their various stages of development and their work.

Botany. A herbarium of 4000 phanerogams, a series of 1500 species of seeds; specimens of woods of Pennsylvania from the state forestry exhibit at the World's Columbian exposition.

The Philadelphia museums, Philadelphia. William P. Wilson *director*; Gustave Niederlein, *chief of the scientific department*; Frederic Lewton, *curator of natural products*; Ernst Fahrig, *chief of laboratories*; George E. Lindin, S. Frank Aaron, Alexander MacElwee, Charles R. Toothaker, *assistants*.

The collections are almost exclusively economic, and are intended to represent in the best manner possible the commercial products and commerce of all countries of the world. They are at present classified under five principal heads: 1) materials of plant origin—including woods, fibers, tans, dyes, gums, resins, oil seeds, oils, coffees, drugs, tobaccos, grains, fruits, foods, herbariums, etc.; 2) materials of animal origin—wools, hairs, furs, skins, pelts, hides, food fishes, shellfish, silks, waxes, honeys, cochineal, sponges, pearl, etc.; 3) materials of inorganic origin—ores and metallurgic preparations, coals, petroleums, clays, coloring earths, salts, flints, sulfurs, building materials, etc.; 4) materials showing the habits and customs of nations—garments, ornaments, models of boats, carts, barrows, cars and other vehicles, utensils of domestic use, agricultural implements, weights, measures, legal forms and commercial headings, current money, games, weapons, musical instruments, etc.; 5) manufactured goods including articles imported by various countries except from the United States, articles made in various countries for home consumption, articles made in various countries for export.

The collections are rich in all departments and all told include about 250,000 specimens (estimated carefully). Particular mention should be made of the collections of foreign cabinet woods, fibers, gums and resins, grains, drugs, coffees, raw silks, raw wools and manufactured textiles, all of which are probably unsurpassed. A herbarium has recently been established which contains 7000 specimens and is growing rapidly. Mention should be made of a type collection of reptiles from Colombia, which includes some 13 new species described by the late Prof. Cope in a paper not yet published.

An extremely important department is the Commercial museum's bureau of information. Its primary object is to promote international trade, particularly the foreign commerce of the United States. To this end, it gives information of the

natural resources and raw products of all countries. It has thousands of correspondents in commercial centers of the world, and at frequent intervals sends members of its staff to the four quarters of the globe. This information thus secured is placed at the disposal of American business men, and the activity of the museum in this direction is a principal and very potent factor in the promotion of American trade abroad.

Swarthmore college museum, Swarthmore. Spencer Trotter of the department of biology in charge.

Mineralogy and geology. The Joseph Leidy collection of exceedingly choice cabinet specimens of crystallized minerals, characteristic rocks and ores, and transparent and opaque models of the various systems of crystallizations; the Robert R. Corson collection of stalactites, stalagmites and helictites, illustrating the limestone formations of the Luray caverns, the second in magnificence in the world; an educational series of rocks from the United States geological survey.

Zoology. The Wilcox and Farnum collection of mounted birds, including nearly all the species which inhabit, or visit, the state; a collection of several hundred bird skins for study and reference; a large series of partial and complete skeletons prepared at Ward's natural science establishment illustrating comparative osteology and the structure and framework of backboned animals; the C. F. Parker collection of choice typical land, freshwater and marine shells; a large and constantly increasing collection of stuffed and alcoholic examples of vertebrates and invertebrates (including the United States fish commission educational collection); of dissected specimens for demonstration in lectures; glass and papier-maché models of invertebrates, and of special points in morphology.

Botany. 2000 specimens: the Eckfeldt herbarium illustrative of the flora of Pennsylvania.

Ethnology. The Frederick Kohl ethnologic collection, containing Indian implements, weapons, clothing, etc., mostly from Alaska; the North Greenland collection, deposited by Samuel J. Entrikin of the Peary expedition.

The collections of the college are strictly for use in teaching, the specimens being in constant use in the lectures and in the

laboratories. They are growing steadily, but always in the direction of rendering more perfect the means of illustrating the different branches of natural history, and with no intention of building up a collection of curiosities or miscellaneous articles.

Thiel college, Greenville. No report.

University of Pennsylvania, Philadelphia. Amos P. Brown, *professor of mineralogy and geology*; John M. Macfarlane, *professor of botany and director of the botanic garden*; Edwin G. Conklin, *professor of zoology*; and Stewart Culin in charge of the ethnologic collection.

Paleontology. 15,000 specimens: a series of fossils from the various Paleozoic formations of New York state, some of which are the type specimens described in the *Paleontology of New York*; Cretaceous fossils from the western states; Cenozoic and Mesozoic fossils from the Gulf and Atlantic coasts; many type specimens of the Galveston Tex. deep well fossils; various individual type specimens, and small collections; and a duplicate set of a part of the Paleozoic invertebrate fossils collected by the Pennsylvania geological survey. Monographic collections of certain groups are also included; as for example Bryozoa by Ulrich, and Ostracoda by Bassler.

Specimens from the Atlantic and Gulf coasts of Eocene, Miocene and Pliocene invertebrates in excellent condition, for exchange.

Mineralogy. 20,000 exhibited specimens and 5000 duplicates forming a nearly complete series of the known and recognized species of minerals. New York, New Jersey, Pennsylvania and North Carolina are specially well represented; Europe and the western states are also well represented. The collections of Dr F. A. Genth, Prof. E. D. Cope and Dr S. B. Howell, of the university, are included, also numerous donations, including the important Clay collection and about 100 duplicate specimens from the Bement collection. The recent purchase of the Cardeza collection of minerals of southeastern Pennsylvania and adjoining states has increased the collection by some 10,000 specimens. Dr Genth's corundum alterations are represented by a set of specimens.

Specimens from New York, New Jersey and the west and many local minerals for exchange.

Historic geology. Material illustrating the Paleozoic age generally, the Cretaceous of America, the general Mesozoic of Europe, and the Cenozoic of eastern America.

Economic geology. 2000 specimens: ores representing all of the principal western mining localities, specially those that were prominent 15 years ago; iron ores and coals from various parts of the United States.

Lithology. 2000 specimens of rocks illustrating the typical formations of America and Europe. Specimens of the local rocks, and ores from the west, chiefly gold and silver for exchange.

Zoology. 3000 vertebrates: material for a synoptic and comparative anatomic collection; the osteologic collection of the late Prof. Cope, including the Hyrtl collection of nearly 1000 beautifully prepared fish skeletons, which formed the basis of much of Prof. Hyrtl's studies on the osteology and of Prof. Cope's work on the classification of fishes; illustrations of local fauna; very complete collections of fishes; batrachians, lizards and birds from Pennsylvania, New Jersey, Jamaica, the Bahamas and the Grand Cayman.

10,000 specimens of invertebrates: a collection of many groups from the Bahamas and Jamaica obtained by the university expeditions of 1887 and 1890-91; the Leidy collection of parasites, including many types; the C. Pennock conchological collection; the Wheatley collection of the fresh-water mollusks of the world; and a large series of models and preparations illustrating the embryology and anatomy of both vertebrates and invertebrates. A vivarium containing living marine, fresh-water and land animals of almost every class.

Botany. A herbarium of 23,000 sheets: an extensive collection of alcoholic specimens for class use and 1200 alcoholic museum specimens illustrating comparative morphology; a set of the De Royle botanic models; and a botanic garden collection including 3200 species of living plants.

Ethnology and archeology. Five sections, each one of which is in charge of a curator.

The American section contains a very complete exhibit of antiquities from the cliff dwellings of Colorado presented by

Mrs Phere A. Hearst, and a similar exhaustive collection from Pachacamac, Peru, excavated by Dr Max Uhle and given by the late Dr William Pepper. These are displayed on two sides of the principal American hall. Lack of space prevents the public exhibition of other American collections, although the latter are available for purposes of study. They comprise a large and representative series of antiquities of the eastern United States, mound pottery and relics, and some 3000 American craniums; and are supplemented by extensive collections from existing tribes, notably a fine Eskimo collection from Point Barrow, Alaska, the gift of the Hon. John Wanamaker, and an extensive collection made during 1900-2, also at the expense of Mr Wanamaker. The Brinton library of works on American ethnology and linguistics, deposited by special arrangement with the university trustees in the museum library, greatly facilitates research in these departments. Mexico and Central America are represented by casts of monuments and valuable collections of pottery and stone implements.

The general ethnologic collections are contained in three halls, one of which is devoted to the Furness, Harrison and Hiller collections from Borneo. The same donors have recently presented a similar valuable series from the Naga Hills in Assam, and a representative series illustrating the life of the Ainos of Japan has recently been received from Mr Alfred C. Harrison and Dr H. M. Miller. Notable features of this section are comparative collections of musical instruments, fans and games, as well as a comprehensive collection of coins. Korea, China, Japan, Siam, Burma, Morocco and Russia are also represented by large exhibits.

The Babylonian and general Semitic section contains a large and extremely valuable collection of antiquities, the greater portion of which is the result of extensive excavations of the ruins of Nippur, in central Babylonia. Much time and labor have been expended in a thorough exploration of the principal mound of these ruins, which covers the temple of Bel, presumably the oldest sanctuary in Babylonia. Among the most important objects thus secured are about 35,000 cuneiform documents in clay. The Babylonian museum is the most important in America, and ranks immediately after the British

museum and the Louvre. The cuneiform documents of the fourth and second millennium B. C. can nowhere be studied to greater advantage. Hundreds of terra cotta and glass vases; Hebrew and Syriac bowls; about 700 fragments of the most ancient inscribed stone vases and votive tablets; nearly 600 seal cylinders; clay coffins; charms; a large amount of gold and silver jewelry, and other objects of art; all serve to illustrate the life and customs of the ancient inhabitants of Mesopotamia, and of the Semites in general. The committee in charge having, in 1898, obtained from the sultan a firman granting permission to continue its excavations at Nippur for a term of three years, and having raised \$30,000 for the purpose, deemed it expedient to concentrate its efforts on two seasons. The wisdom of this decision has been justified by the importance of the results. Foremost among these is the discovery of the library of the temple, from the ruins of which large numbers of precious ancient documents have been exhumed, and brought to the university where they will be published.

Under the reorganization of the department, which took place in 1899, the section of casts has ceased to exist. Already, in 1898, the committee had voted the funds at its disposal to the Egyptian and Mediterranean section for the purpose of securing some original ancient sculptures; and the casts acquired through its efforts were distributed and installed in the sections to which they respectively belonged. Thus the reproductions of important Central American monuments from Quiriguá and Copan may now be seen in the American section; while the great bas-reliefs of Trajan's arch at Benevento, and the important series of marbles found in the neighborhood of Lake Nemi on the site of a temple of Diana Arecina, form the most striking feature of the Greco-Roman hall in the Egyptian and Mediterranean section.

The Egyptian section has secured important series of objects illustrating the history, arts and industries of Egypt, from prehistoric times down to the Greco-Roman period. From the Egypt exploration fund, the American exploration society and the Egyptian research account, the committee in charge each year receives a fair share of the objects discovered.

In 1898 the museum was enriched by a fine seated Ka-statue of an Egyptian nobleman called Nenkhefttek, who lived under the fifth dynasty, and whose tomb at Deshasheh was opened that year. With it have come the skeleton of the original and other valuable sepulchral deposits of the old Egyptian empire. From Behnesa an interesting collection of objects of the Roman period was obtained. The most important part of the acquisitions from this site, however, is a portion of the rich find of Greek papyri, which will eventually come to the museum.

In 1899 objects of inestimable value, dating from the earliest dynasties, were received from Hierakonpolis, among them being a superb alabaster vase inscribed in the name of King Kha-Sekhem, and 10 ivory carvings representing the men and women who inhabited the Nile valley about 4500 B. C. Interesting acquisitions from Dendera and Hu were also added.

In the years 1900-2 the work of the Egypt exploration fund proved of more than usual importance. Having obtained permission from the Egyptian government to go over the ground just excavated by a French syndicate at Abydos, Mr Petrie's finds and scientific results were of the utmost interest, the collections from this earliest stratum of Egyptian history having proved of peculiar value. Through the liberality of the American exploration society, which has assumed the financial responsibility involved in cooperating with the Egypt exploration fund on behalf of the department of archeology, a liberal share of the objects discovered will come to Philadelphia. Among these are a stele of King Qa, and several stone fragments and ivory tablets inscribed in the names of other and early successors of King Mena.

Of the founder of the United Egyptian Empire himself, an ebony tablet inscribed in his name may be seen, as well as other fragments and objects of his reign. Inscriptions and objects from the tombs of kings of the 1st, 2d, and 3d dynasties and even of pre-Menite rulers are among the new series. It is therefore fair to state that the collection, as far as regards the Archaic period, is unique in this country.

The Mediterranean collection comprises an important series from Cyprus and interesting Greek, Etruscan and Roman antiquities.

The excavation of some Etruscan tombs at Narce, Chiusi, Cervetrii, Vulci, Bizantium, Ascoli, Civita Castellana, Orvieto, Corneto and Tarantum, undertaken for this section, resulted in a splendid series containing a number of unique specimens.

Among these six Etruscan sarcophagi of stone representing the defunct reclining on his bier, excavated at Civita-Musarna, near Viterbo (third century B. C.) are a striking feature. These collections are the gift of the late Dr Pepper, of Mrs Hearst and the American exploration society and of the Hon. John Wanamaker. The Dillwyn Parrish collection has been enriched by a collection of demotic papyri, which will be added to its already important series of ancient manuscripts.

An expedition sent to Crete on behalf of the museum by the American exploration society, in the summer of 1901, under the direction of Miss H. A. Boyd and Miss Wheeler resulted in the discovery at Gournia of a Mycenaean town of about 1200 B. C. Paved and drained, albeit narrow streets, houses, a shrine and a palace were brought to view, and many objects of pottery, bronze, stone, etc. were discovered. A complete series of enlarged photographs illustrate in the museum this important discovery.

Two of the most valuable and interesting exhibits of the museum are deposited in the section of glyptics to which the western wing of the first floor of the Museum building is devoted. One consists of an exceedingly valuable collection of engraved gems and amulets presented to the university by Prof. Sommerville; the other a completely equipped Buddhist temple, also the gift of Prof. Sommerville.

The glyptic collection represents the life work of its donor, and covers epochs of gem engraving from the earliest eras to the present time. They are so arranged that visitors may, through the medium of these beautiful engraved stones, cylinders, seals and Gnostic tokens, inform themselves intelligently on the science which these gems of all epochs so notably exemplify.

A large number of objects from Buddhist temples, secured by the donor in his travels through the Orient, have been

arranged in the form of a Buddhist temple. This shrine contains gods, effigies, symbolic flowers, temple furniture, and fittings of every description secured from places of worship in almost every eastern country. During the winter months, Prof. Sommerville gives a series of public lectures on "Buddhism" in this unique temple on Sunday afternoons at 2.30 o'clock.

The collections are open to visitors daily, holidays excepted, from 10 a. m. to 5 p. m. On Sundays, they are open from 2 p. m. to 6 p. m.

For the prosecution of special studies in the museum, application should be made to the various curators in charge of the several sections.

Wagner free institute of science, Philadelphia. Thomas L. Montgomery, *actuary*; Thomas H. Montgomery jr, *director* of museum; Charles W. Johnson, *curator* of museum.

Paleontology. 20,000 specimens: a general collection arranged stratigraphically, specially rich in American Tertiary.

Mineralogy. 2000 specimens: a general and a local collection.

Zoology. 25,000 specimens: local, general and synoptic collections.

Botany. 1000 specimens: a local collection; a set of "*Musci boreali-Americani*" by Sullivant and Lesquereux.

Ethnology. The Clarence Bloomfield Moore collection of 1200 relics from the fresh-water shell mounds of the St Johns river valley, Florida; described in the *American naturalist*, 1892-93.

Free lectures are given at the Institute on the following subjects: chemistry, biology, geology, physics and engineering. Classes are formed in connection with the lectures, the institute providing the textbooks, and the museum furnishing material for study. The William Wagner reference collection of books on natural science is open to the public every day for reference purposes and there is a branch of the free library of Philadelphia in the building which furnishes books for home use.

Washington and Jefferson college, Washington. Edwin Linton, *professor of biology and geology*, in charge.

Paleontology. Collection contains several hundred exhibited specimens, and three or four times as many which are not yet

arranged. The collection is particularly rich in fossil plants of the upper Coal Measures.

Mineralogy. 2500 specimens: a general collection for purposes of illustration in lectures and class work; rich in silicifications from Colorado and ores of silver and copper from Tombstone Ariz.

Historic and economic geology. 1000 specimens: collections distributed from the United States geological survey and the second geologic survey of Pennsylvania; a series collected in Connecticut and Massachusetts; and specimens illustrating the formations of several mines belonging to the Anaconda mining company in Montana.

Zoology. 2000 specimens exclusive of duplicates: a systematic collection of the marine invertebrates and fishes of southern New England; tropical shells and corals; two collections of fresh-water shells; and a number of skeletons and other material for classroom illustration.

Botany. 500 specimens exclusive of duplicates: 110 species of phanerogams from northern India, 108 from Indiana and a number from Connecticut; an incomplete series of phanerogams and ferns from western Pennsylvania; 130 species of the mosses of western Pennsylvania collected and identified by Prof. Linn and Prof. Simonton of the college.

Ethnology. 800 specimens: material illustrating the industries, products and particularly the religious customs of the people of China, Japan, India, Siam, etc.; a collection from the tribes along the west coast of Africa; pottery etc. from Alaska and New Mexico.

Westminster college, New Wilmington. No report.

RHODE ISLAND

Brown university, Jenks museum of zoology, Providence. A. D. Mead, *curator*.

Paleontology. 10,000 specimens: a small general collection of fossils; an exhaustive series of the fossils from the Carboniferous formations of Rhode Island. Duplicates for exchange.

Mineralogy. A general collection of 5000 specimens. Material for exchange.

Historic geology and lithology. 500 specimens intended for class work.

Zoology. 25,000 specimens: general synoptic collections illustrating the various divisions of the animal kingdom; a series illustrating the geographic distribution of Rhode Island fauna. Duplicates for exchange.

Ethnology. 1000 specimens.

The museum includes the collection of the Rhode Island medical society.

Museum of natural history, Roger Williams Park, Providence.
James M. Southwick, *curator*.

Paleontology. 750 specimens of general interest, including trilobites, crinoids, mollusks, fish and mammal remains; 70 specimens of plants from the Carboniferous rocks of the state.

Mineralogy. 1200 specimens illustrating 400 species and varieties: some excellent specimens, both European and American.

Historic geology. Collections chiefly illustrate the result of glacial action in Rhode Island.

Zoology. 6000 specimens: 250 species of sponges, corals and echinoderms; 1000 species of shells; 1200 species of insects; 30 species of fish; 25 species of reptiles; 500 species of birds and mammals; 125 species of eggs; the collection of mounted Rhode Island birds practically complete containing 292 species and 490 specimens.

Ethnology. 3000 specimens of Rhode Island aboriginal implements and 2000 specimens of implements from the United States and Canada; 40 specimens of dress of North American Indians; and a few implements from the South Sea islands.

There is a library of 950 books and pamphlets treating of the various objects in the museum, intended for study and reference, but not for general circulation.

Rhode Island college of agriculture and mechanic arts, Kingston.
John H. Washburn, *president*.

Collections are as yet only small synoptic series for class use.

SOUTH CAROLINA

Claffin university, Orangeburg. W. J. Morrill, *director*.

Paleontology. 250 specimens: teeth and bones from phosphate rock.

Mineralogy. 3000 specimens: kaolinite, monazite sand and other South Carolina minerals.

Historic and economic geology and lithology. 300 specimens.

Zoology. 1500 specimens: mammals, birds, reptiles, shellfish, insects and lower forms. Coleoptera and Lepidoptera for exchange.

Botany. 1000 specimens: pressed plants and blocks of wood sections. South Carolina species of jessamine, azalea, dogwood, magnolia, long-leaf pine, etc. for exchange.

College of Charleston, Charleston. George H. Ashley, *curator and professor of biology and geology*, in charge.

Paleontology. 5000 specimens, including many types of fossils from phosphate beds, Tertiary invertebrates from Alabama, and a small collection from Europe and points in this country. The Tertiary is well represented. The museum has for exchange some shark's teeth from type localities.

Mineralogy. About 2000 specimens. Shepard collection of phosphate rocks, native and foreign; a collection of Russian minerals; Florida phosphates; Shepard general collection and small collections.

Economic and historic geology and lithology. About 200 or 300 specimens.

Zoology. About 7000 specimens. Mammals, mounted skins 200, one fourth of which are characteristic exotic species, and one fourth range in size from the camel to the Malay tapir; skeletons 125; birds, mounted skins 800, including a large and choice series of exotic forms, skeletons 50, eggs 250, nests 70; reptiles and amphibians, mounted skins 75, skeletons 20, in alcohol 95 jars; fishes, mounted skins 100, skeletons 20, in alcohol 115 jars; invertebrates, 5000; types of Audubon and Bachman's mammals. The museum has for exchange some specimens of mollusks, etc.

Botany. 5000. Elliott herbarium, rich in types; Ravanell herbarium; Biltmore herbarium and many others.

Ethnology and anthropology. About 500-1000 specimens. Casts of Assyrian, Egyptian, Grecian, Aztec, monumental art, mummy and cases; copies of Etruscan vases; between 500 and 1000 miscellaneous specimens, Indian, South Sea, African, etc.

The collections are now being rearranged.

Furman university, Greenville. W. F. Watson, *professor of chemistry and natural history*, in charge.

Paleontology. Collection small.

Mineralogy. A fair collection of the most common minerals from a great variety of localities; a limited number of good crystals.

Lithology. 300 specimens.

Zoology. A fine collection of stuffed mammals, birds and reptiles, known as the Marshall museum, of great value and very useful.

Ethnology. 100 specimens: implements and utensils of the American Indians.

South Carolina college, Columbia. F. C. Woodward, *president and professor of English*.

The college museum has twice been destroyed, so that the collections now are little more than what are needed for class use.

Wofford college, Spartanburg. No report.

SOUTH DAKOTA

South Dakota geological survey, Vermilion. James E. Todd, *state geologist*.

The collections made by this department are in the custody of the University of South Dakota, and are described with the other collections of that university.

State school of mines, Rapid City. Cleophas C. O'Harra, *professor of mineralogy and geology*, in charge.

Paleontology. 900 specimens: 300 Cretaceous fossils; 200 specimens (parts of vertebrates) from White River Bad Lands; 400 miscellaneous.

Mineralogy. 3000 specimens: mostly Black Hills minerals.

Historic and economic geology and lithology. 1200 specimens: ores and sedimentary, metamorphic and igneous rocks of the Black Hills region.

University of South Dakota, Vermilion. J. E. Todd, *professor of geology and mineralogy*; C. P. Lommen, *professor of biology*, in charge.

Paleontology. 1125 specimens representing 500 species: a general collection of 125 representing 50 species; 500 representing 300 species of the Paleozoic invertebrates; 350 representing 100 species of Mesozoic invertebrates, largely from Dakota; 200 representing about 50 species of the fossil vertebrates, mostly from the Miocene formations of Dakota; and a number of fossil vertebrates from other Tertiary formations.

Mineralogy. 700 specimens: a crystallographic collection of 250 specimens representing 100 species; a general collection of 400 specimens representing 250 species; and microscope slides of 150 species and varieties.

Economic geology. 150 specimens of nonmetallic and 250 metallic ores.

Lithology. A general collection of 300 specimens; a series of 150 of Ward's typical rocks.

There is also a collection illustrating stratigraphic geology.

Zoology. 900 specimens representing 843 species: an educational collection of 475 specimens representing 435 species, from the German exhibit at the World's Columbian exposition; 15 representing 11 species of Australian mammals; 19 representing 17 species of Australian birds; 130 specimens and species of North American fishes received from the Smithsonian institution; a series of 200 specimens and species of Dakota insects; and 500 microscope slides.

Botany. 1200 specimens representing 193 species: 43 models of different species of German fungi; a herbarium of 1000 specimens and species of the flora of Germany; and Dakota flora, numbering 157 specimens representing 150 species.

The collections of the state geological survey are included with those of this university.

Yankton college, Yankton. George A. Clark, *professor of biology*, in charge.

There are fairly good working collections in zoology, including typical specimens of all the subkingdoms; collections illustrating the local flora; and several cabinets of rocks and minerals.

These collections are not arranged for exhibition as a museum.

TENNESSEE

Carson and Newman college, Mossycreek. No report.

Cumberland university museum, Lebanon. James S. Waterhouse, *professor of chemistry and natural science*, in charge.

Paleontology. 1500 fossils of general distribution; a number of casts of famous fossils.

Geology and mineralogy. 600 specimens: a general study series. Also a collection of rocks furnished by the United States government.

Zoology. Small collections of dried and alcoholic specimens. A fine collection of Japanese shells, including 500 species with many duplicates.

Botany. Only a few specimens besides a good series of microscope slides.

Fisk university, Nashville.

Small general collection.

Zoology. 500 specimens.

Botany. 2000 specimens.

Small working collection of rocks and minerals.

Maryville college museum, Maryville. A. F. Gilman, *professor of chemistry and mineralogy*; M. E. Kennedy, *professor of biology, botany and geology*; Hugh R. Crawford, *assistant*.

Paleontology. 750 specimens: college collection of coal fossils, calamites, ferns, club mosses etc.; Black River corals; massive fossiliferous limestone; Bates collection of miscellaneous fossils; Webb collection of fossils of the Cincinnati period. About 100 Black River corals and fossils of the Cincinnati period for exchange.

Mineralogy. 1000 specimens: Dr F. Kantz collection of 200 specimens from Europe; college collection of 400 typical specimens from the United States; A. F. Gilman collection of 450 New England typical specimens; all classified according to Dana. About 100 duplicates for exchange.

Historic and economic geology and lithology. 200 specimens: United States government collection of 150 specimens of rocks of the United States; Keefe collection of choice specimens of Tennessee and Vermont marbles.

Zoology. 300 specimens: 100 birds eggs; Fisher collection of 150 alcoholic fishes of the United States; 100 dried specimens of echinoderms, corals, sponges, etc.

Botany. 478 specimens: Caulkins collection of 400 choice specimens of lichens of Tennessee; M. C. dendrology club's collection of 78 specimens of woods of natural growth on the campus.

Ethnology. 410 specimens: M. C. club of Japan collection of 150 specimens of Japanese books, weapons, garments, armor, household utensils, coins etc.; 20 Chinese articles, 50 Indian; 30 Persian; 150 Mound Builders relics; 10 American Indian specimens.

The museum also contains class flags, foreign flags and banners, some of the original scientific apparatus of the college, the first communion set brought into east Tennessee, the spinning wheel of the wife of the founder of the college, and a series of ancient books and manuscripts.

Milligan college, Milligan. No report.

Southern normal university, Huntingdon. No report.

Southwestern baptist university, Jackson. No report.

Southwestern presbyterian university, Clarksville. S. R. McKee, professor of chemistry, in charge.

Mineralogy. 6000 specimens prepared for inspection and study.

Lithology and paleontology. A large collection of rocks and fossils.

Zoology. 16,000 shells; on exhibition in the Stewart Cabinet building.

Botany. 500 mounted specimens.

University of Tennessee, Knoxville. Samuel M. Bain, *professor of botany*.

Paleontology. Small collection of casts and fossils.

Mineralogy. A small working collection.

Zoology. Several thousand insects and a small collection of alcoholic specimens of other animals.

Botany. 30,000 specimens including many types of Chapman, Gattinger, Scribner and others.

Duplicates for exchange.

Ethnology and anthropology. Small collection of Indian relics and casts of same.

Vanderbilt university, Nashville. L. C. Glenn, *professor of geology*, in charge; George W. Martin, *professor of biology*.

Paleontology. 15,000 specimens: Sturtz and Krantz collections; the Safford collection of Tennessee Paleozoic fossils and Mesozoic and Cenozoic fossils from Tennessee and Alabama; the Glenn collection of Atlantic coast Cenozoic invertebrates. Material for exchange.

Mineralogy. 4000 specimens: Sturtz and Krantz general collections.

Historic and economic geology and lithology. 2500 specimens: classic European and American rocks, both igneous and sedimentary; Tennessee Paleozoic rocks.

Some Tennessee rocks for exchange.

Zoology. 2000 specimens: the commoner forms of Tennessee and the south; both vertebrates and invertebrates; shells; some forms from the Woods Hole station. Material for exchange.

Botany. 5000 specimens: collections of lichens and algae. Material for exchange.

Ethnology and anthropology. 800 specimens: stone and bone articles and pottery from the Tennessee and Florida mounds.

Walden university, Nashville. Harold Steele, *professor of natural science*, in charge.

Paleontology. 100 specimens: material illustrating the fauna of the Lower Silurian formations in Tennessee, and of the Carboniferous formations of northern Illinois. A few brachiopods and corals for exchange.

Mineralogy. 400 specimens: a small general collection; a series of gold and silver ores from Colorado; and iron ores from Tennessee. A few Tennessee minerals for exchange.

Economic geology. 50 blocks of building stones of Tennessee, besides the material mentioned in the mineralogic collection.

Zoology. 1000 specimens: a series of the mammals, reptiles, batrachians, etc., of Tennessee; 116 mounted birds of general distribution; a study series of 400 birds illustrating the avifauna of Colorado and Tennessee; 50 sets of birds eggs; small collections of shells and stuffed fishes and 8000 insects.

Insects of all orders, birds, birds eggs and reptiles for exchange.

Botany. A herbarium of 300 specimens representing 150 species. 100 specimens for exchange.

Ethnology. 150 specimens from Africa, chiefly handiwork of some of the native tribes; a collection of coins and currency of various nations.

In the museum of the medical department of the college are collections of chemicals prepared by the students; crude drugs; and a series of pathologic specimens.

TEXAS

Howard Payne college, Brownwood. No report.

University of Texas, Austin. This university does not maintain a museum, but has collections in geology, biology, botany, etc., which are used for purposes of instruction. All books, collections, specially rich in new or recently described forms, both vertebrate and invertebrate, as well as in minerals illustrative of the resources of the state; and also apparatus and specimens belonging to the discontinued Geological survey of Texas authorized by an act of the state legislature have now been installed at the university, thus more than doubling its resources. Frederic W. Simonds, *professor of geology*; William M. Wheeler, *professor of zoology*; William B. Phillips, *professor of field and economic geology*; and William L. Bray, *adjunct professor of botany*.

Paleontology. American Paleozoic fossils; a series of Texas Cretaceous fossils, and Texas Tertiary fossils presented to the

university by George W. Brackenridge, a member of the board of regents.

Mineralogy. A general collection of specimens from all parts of the world; a series of typical crystals and a collection sent by the United States national museum.

Economic geology. A series of specimens illustrating the mineral resources of Texas; a collection illustrating the occurrence of lead and zinc in southwest Missouri.

Lithology. A general collection of rocks from all parts of the world; collections sent out by the United States national museum and by the United States geological survey; a set of rocks from the typical American localities, with slides for microscopic study.

Zoology. A complete set of the Leuckart and Niche zoologic wall charts; Brendel's and Ziegler's models; the Linnaea alcoholic preparations; several fine skeletons; and a local collection.

Botany. A herbarium of Texan plants, Kny botanical charts, and others hand painted.

Ethnology. The Swenson collection of coins and medals. A few years before his death, S. M. Swenson gave the university a valuable collection of coins and medals. Of the 3476 coins, 2217 are bronze, 1172 silver, and 87 gold. Many of these coins were in use before the Christian era, and, with few exceptions, none are of more recent date than the sixth century. Of the 1846 medals, 607 are silver and the remainder bronze and white metal, plated and gilt. There are 94 Russian medals, illustrating the rise and progress of that country from the time of Ruric to that of Czar Alexander. American, French, English and Swedish medals make up the remainder and illustrate historic events of great importance in these countries. Many of these coins and medals are rare, and their value in the study of history is great. Arrangement has been made to make this collection available for instruction in the university, and for this purpose it has been placed in charge of the professor of history, Dr George P. Garrison.

University of Texas mineral survey, Austin. William B. Phillips, *director*; Benjamin F. Hill, *assistant geologist*; H. W. Harper, *chemist*; O. H. Palm and S. H. Worrell, *assistant chemists*.

Paleontology. Collections specially rich in the fossil remains of the Carboniferous, Permian, Cretaceous and Tertiary.

Mineralogy and geology. Collections include ores of iron, copper, gold, silver, tin, lead, zinc, manganese, uranium and mercury. There has recently been added a complete set of crude oils found in the state and the products refined from them. There is a full set of the various types of rocks occurring in the state, including building and ornamental stones, some of them cut and polished. Asphalt, gypsum and salt horizons are well represented, as also materials for the manufacture of cement, tiles, sewer pipe, bricks, etc.

UTAH

University of Utah, Salt Lake City. R. H. Bradford, *curator*, in charge. This museum is for teaching purposes only, being supplemented by the collections of the Deseret museum at Salt Lake City.

Paleontology. 200 specimens: casts and models as purchased from dealers; miscellaneous collections of fossils.

Mineralogy. 2000 specimens: all the important groups in Dana's textbook.

Historic and economic geology and lithology. 500 specimens: models, charts, etc., and groups of specimens illustrating Tarr's *Economic geology of the United States*; United States government collection in lithology.

Zoology. 2000 specimens: mounted mammals, birds and reptiles; bird skins, alcoholic specimens.

Botany. 1200 dried plants of western United States; 500 European specimens.

Ethnology and anthropology. Scattered specimens.

VERMONT

Fairbanks museum of natural science, St Johnsbury. Delia I. Griffin, *director*; Mary E. Ide, *curator*.

Paleontology. Fossils from the various formations of the state, together with some casts of fossils.

Mineralogy. A small series of minerals and ores from the United States and abroad.

Lithology. A few hundred specimens, mostly from the United States.

Zoology. 4500 specimens: 36 species of mammals native to the state, some of which are mounted in groups to show their homes and habits, and a few from foreign countries; 700 North American and 1000 foreign birds, mounted, including 26 species of Paradiseidae; a small series of bird skins; 39 species of native and foreign reptiles and batrachians; 500 species of Lepidoptera and 1100 species of Coleoptera; and 1100 species of mollusks.

Botany. A herbarium of over 5000 specimens, chiefly phanerogams and vascular cryptogams, together with woods, fruits and grains.

Ethnology. Articles from the American Indians, Mexico, Egypt, South Africa, India, China, Japan, the Pacific islands, etc.

Numismatics and philately. A collection of 1500 ancient and modern coins, and over 2000 postage stamps.

The museum was erected, equipped and endowed by the late Franklin Fairbanks of St Johnsbury. It is free to the public and carries on an educational work in conjunction with the schools of the town.

Middlebury college, Middlebury. Edward A. Burt, *professor of natural history*, in charge.

Paleontology. The Adams collection, which is a general representation of the species from the different geologic formations; the Brainerd and Seely collection of fossils from the Champlain valley, which is particularly representative of the forms from the Chazy limestone. Additions to these collections have been made from several sources.

Mineralogy. A fairly complete set of minerals for the use of the classes.

Lithology. A set of the rocks of Vermont collected by Prof. Adams while conducting the geologic survey of the state; also a series of rocks of Minnesota.

Zoology. The Adams collection of shells, which includes the land and fresh-water shells of Vermont; a mounted collection of the native birds; and a marine collection, largely from the United States fish commission.

Botany. 2500 specimens: Brainerd collection of phanerogams and ferns of the Champlain valley said to lack about 50 species of comprising the full flora of the state; a set of Vermont mosses prepared by Dr Grout; 400 or 500 specimens of the basidiomycetous fungi of Vermont, now accumulating.

Ethnology and archeology. The Chapman collection of apparel and implements from the Yukon valley, Alaska; stone implements; several Assyrian tablets and casts, contributed by the Rev. Dr Farnsworth; and a series of relics of local and general historic interest.

The museum contains, primarily, collections illustrating the natural history of Vermont which have been made from time to time. They have been suitably arranged and cared for, so that they form an educational factor of value to the students.

University of Vermont, Burlington. George H. Perkins, *professor of natural history and curator of the museum*; L. R. Jones, *professor of botany*, in charge of the cryptogamic and local collections herbarium; C. G. Pringle, keeper of the herbarium, in charge of main herbarium; E. C. Jacobs, *professor of mineralogy*, in charge of the mineralogic collections. Student assistants are employed from year to year.

Paleontology. 5000 specimens particularly representative of Vermont formations: the Cambrian fauna from the Georgia slates and the red sandrock of western Vermont; the Calciferous fauna from various localities, including a nearly complete set of the Fort Cassin fossils described in bulletins of the American museum of natural history; the Trenton, Chazy and Black river fauna from various parts of the Champlain valley; and the Brandon lignites with carpolites, etc., from the Tertiary formations; specimens from America or Europe illustrating all the principal epochs.

Cambrian, Trenton and some Calciferous fossils for exchange.

Mineralogy. 5000 specimens: a good general collection of American and European minerals, including some very fine specimens; numerous specimens of Sicilian sulfur, celestite, etc., collected by the Hon. George P. Marsh.

Lithology. 2000 specimens: a series of the marbles and other metamorphic rocks of Vermont; a series of several hundred speci-

mens of the lavas of Vesuvius; and a large series of European rocks.

Zoology. 20,000 specimens: a series of the mammals of Vermont; a small series of skeletons and craniums of vertebrates; several hundred mounted birds, many of which are in their finest plumage, specially complete series of ducks, including a fine male specimen of the extinct Labrador duck; a collection of birds eggs; a series of mounted specimens of Lake Champlain fishes; a series of 6000 insects; a large collection of mollusks; and a considerable number of alcoholic specimens of reptiles, fishes, crustaceans and worms; a group of nine beavers from 6 weeks to 3 years of age, arranged to show the animal in its natural haunts, with a full sized section of a lodge, part of a feeding ground, 13 feet of a dam and a representation of a part of the pond. The materials were collected by Mr W. E. Balch of Lunenburg, in northern Maine, and the work has been done by him with the utmost fidelity to nature.

Botany. About 70,000 specimens; of these some 50,000 are the Pringle herbarium which represents pretty completely, for the vascular plants, the known flora of North America together with a majority of the European species and a good showing from other parts of the world. It is specially rich in Mexican specimens collected by Mr Pringle. The remainder of the collection consists largely of Vermont plants. It includes the herbariums of C. C. Frost and Joseph Torrey and an almost complete representation of the more recent collections of Gront, Eggleston and other Vermont botanists. The aim is to make the collection as broadly and completely representative of the Vermont flora as possible.

Vermont and Mexican specimens are available for exchange, chiefly ferns and seed plants.

Ethnology and archeology. 10,000 specimens: a large series of specimens illustrating Vermont archeology; collections of stone and earthenware utensils from the Mississippi valley, the Colorado cliff ruins, Central America and Peru; arms, implements, etc., from the Pacific islands, Australia and Africa; a very fine collection of Sioux weapons, articles of apparel and ornaments, etc.; an interesting collection of Japanese arms and

armor, and of English swords of the 16th and 17th centuries, halberds, guns, etc.; and a unique and superb collection of oriental (chiefly East Indian) carvings, embroideries, weapons, etc. which are exhibited in a room fitted up in oriental style—the walls hung with costly embroidered fabrics and furnished with carved teak wood. This collection is a recent legacy. There is also a very good collection of Greek and Roman coins and of modern medals and coins from most of the countries of the world, several thousand specimens in all.

In collecting and arranging the specimens the chief objects aimed at are to illustrate the lectures on natural history and so to make the museum a valuable adjunct of classroom work, and to illustrate the natural history of the state of Vermont.

Vermont state cabinet, Montpelier. George H. Perkins, *state geologist*, in charge. The museum is designed to be mainly local, illustrating in all its branches, the natural history of the state. It contains for the most part, Vermont specimens, though these are supplemented to some extent, by specimens of groups not found in the state, e. g. corals etc.

Paleontology. 500 specimens: a series of Cambrian fossils from Highgate and Georgia Vt., including fine examples of the Parker ledge, Olenellus, Mesonacis, etc.; a representative series of Calciferous (Fort Cassin), Chazy, Trenton and Utica fossils of western Vermont, Lake Champlain region; an extensive series of the Carpolithes etc. from the Tertiary Lignite of Brandon; also a nearly complete skeleton of *Delphinapterus leucas* (*Beluga vermontana*); two mastodon tusks nearly complete from the Champlain clay and other Quaternary fossils. The whole number on exhibition is not large because of lack of case room.

Mineralogy. 2000 specimens: a good collection of Vermont species, specially quartz, actinolite, calcite, ores of iron, lead, copper and manganese; also many other species less fully represented.

Historic and economic geology. 5000 specimens: a complete series of the rocks of Vermont collected by the survey of 1856-60; also a nearly complete set of marbles, slates and granites showing the rough and polished surfaces.

Zoology. 2000 specimens: a nearly complete set of the mammals and birds which are or within 50 years have been resident in the state; an alcoholic collection of reptiles and batrachians and a small collection of insects found in Vermont; a collection of several hundred Lepidoptera from other parts of New England and the tropics mounted on Denton tablets; also small but very good collections of corals and mollusks and 100 crania of mammals and birds.

Botany. 1500 specimens: a set of native plants collected and mounted by Mr C. G. Pringle.

Ethnology. 200 specimens: stone, copper and earthenware objects from various localities in the state.

VIRGINIA

Emory and Henry college, Emory. Small collections of rocks and minerals.

Roanoke college, Salem. No report.

State museum, Virginia military institute, Lexington. Hunter Pendleton, *professor of chemistry*, and N. B. Tucker, *professor of mineralogy and geology*, in charge.

Paleontology. 720 specimens collected from the various geologic formations; richest in fossil plants from the Coal Measures, and mollusks of the Tertiary system.

Mineralogy. 3525 specimens: a general collection of 2350 specimens; a fairly complete collection of 1175 Virginia minerals; minerals of the different counties of the state specially the tin, iron and manganese ores from Rockbridge and Augusta counties; also a series of gold and silver ores from the Cripplecreek, Aspen and Leadville districts of Colorado.

Lithology. 386 specimens: collection illustrating the metamorphic and igneous rocks of the Appalachian system; also collection of rocks illustrating: 1) unaltered sedimentary rock of mechanical origin; 2) unaltered sedimentary rocks of chemical origin; 3) unaltered sedimentary rocks of organic origin; 4) unaltered igneous rocks; 5) metamorphic sedimentary rocks; 6) metamorphic igneous rocks; 7) residual rocks.

Economic geology. Marbles and building stones; collections illustrating the products and byproducts of brine; dressed orna-

mental stones; products and byproducts of petroleum and mineral paints.

Zoology. 1500 specimens: molluscan shells, with a very few representatives of the other subkingdoms.

The museum also contains specimens illustrating tobacco from the crude leaf to various manufactured products; the manufacture of cotton and linen fabrics; various iron and steel products; oils and varnishes; artificial stones and stonework; silks and their dyestuffs; rubber in various stages of manufacture; fertilizers; products from the Rumford chemical works; powders, and other industrial products. There is also a series of 288 materia medica specimens.

University of Virginia, Lewis Brooks museum, Charlottesville. William M. Fontaine, *professor of natural history and geology.*

The museum has no staff apart from the professor teaching the subjects illustrated in it. Each professor has charge of his own department.

Paleontology. 8000 fossils illustrating the life of all formations, particularly forms from the Triassic, Jurassic and Cretaceous; a number of restorations, both life size and reduced, of large vertebrates, either entire or in part; and a number of plaster casts of famous fossils.

Mineralogy. 4000 specimens: a large general collection; series of specimens illustrating phenomena, color, structure and physical properties; a collection of models of meteorites; models of gold nuggets; imitation gems and a set of crystal models.

Historic geology and lithology. Lavas of Vesuvius; typical rocks from the Alps; a series of typical rocks of the New York formations, and from Auvergne, Paris Basin, Saxony and Virginia; an historic series from the different formations, and illustrative collections of igneous, metamorphic and fragmental rocks and a set of relief maps.

Economic geology. 4500 specimens: ores of Virginia; foreign (chiefly Italian) and domestic marbles, and a collection of building stones.

Zoology. 5000 specimens fully illustrating all the principal animal groups: mounted specimens; skeletons; alcoholic prepara-

tions; plaster models of many forms; enlarged models in wax of polyps, etc.; a large series of corals, dried specimens, etc.

Botany. 30,000 specimens: herbariums of Europe, North America, West Indies and Syria; collections of fruits and models of them; woods; dissected models of fruits and flowers; and pressed specimens of typical plants with engravings of their parts.

Ethnology and archeology. Collections very small.

The museum is composed of specimens intended strictly for illustrating the principles of the sciences taught, the aim being to give full representation of the natural objects. It is strictly a teachers museum.

Virginia polytechnic institute, Blacksburg. Ellison A. Smyth, in charge of natural history museum; John Spencer, *state veterinarian*, veterinary department; Robert C. Price, *mineralogy*; W. B. Alwood, *state entomologist*, in charge of fungi, scale insects, etc. in station building.

Mineralogy. 900 species: the various groups of ores (oxids, carbonates, sulfids, silicates, etc.); metals of economic value; minerals of industrial importance.

Historic and economic geology and lithology. 800 species: various classes of rocks and different formations; an educational series presented by the United States geological survey.

Zoology. 1200 North American bird skins; a small collection of mounted birds; shells, marine invertebrates, etc., sufficient to illustrate the work of the institute in zoology; on deposit for an indefinite time, 3500 species, 25,000 specimens, rich in the genus *Papilio* (236 species) and the *Sphingidae* (145 species) of native and exotic butterflies and moths; the station collection of native insects, rich in *Orthoptera* and *Coleoptera*, containing 4000 species and 10,000 specimens, 60 species being scale insects on 125 different host plants; 1000 histologic slides; 50 species of alcoholic snakes, lizards, etc.; skulls of alligator, turtle, porpoise, cat, dog, etc.; mounted skeletons of monkey, sheep, dog, cat, horse, cow, squirrel, birds, turtle, fish, etc.; a large lot of animal parasites in alcohol and microscopic specimens.

Lepidoptera for exchange.

Botany. 3000 species of *spermophyta* and ferns; 550 specimens of fungi; seeds of native weeds.

WASHINGTON

Ferry museum, Tacoma. Meriden S. Hill, *secretary*, in charge.

Paleontology. 150 specimens.

Mineralogy. 250 specimens.

Historic geology and lithology. 50 specimens.

Zoology. 50 specimens.

Ethnology. 200 specimens. Also large collections of paintings, etchings, engravings, photographs, old books, armor, coins, statuary, curios and articles of vertu.

State agricultural college, Pullman. C. V. Piper, *professor of botany and zoology*; Solon Shedd, *professor of geology and mineralogy*; R. H. Snodgrass, *assistant professor (entomology)*; H. S. Davis, *assistant in vertebrate zoology*; R. K. Beattie, *assistant*.

Paleontology. 1000 specimens, general study collection.

Mineralogy. 800 specimens.

Lithology. 600 rocks.

Zoology. 5000 specimens of mammals, birds, mollusks, echinoderms, etc. 100,000 insects. Insects and mollusks for exchange.

Botany. Herbarium contains 40,000 sheets of phanerogams and pteridophytes, 2500 bryophytes, 5000 fungi, 200 algae. Phanerogams, bryophytes and fungi for exchange.

Ethnology. 500 specimens stone implements, etc. There are also collections illustrating agriculture, horticulture and veterinary science, pathologic and anatomic specimens.

Tacoma academy of science, Tacoma. Museum in charge of the secretary, Meriden S. Hill, who is also secretary of the Ferry museum.

Geology. 500 specimens.

Ethnology. 1000 specimens.

University of Washington museum, Seattle. Henry Landes, *state geologist*, in charge.

Paleontology. 2000 specimens of invertebrate fossils from Silurian formations; 1500 specimens of miscellaneous material derived from various sources, including the skull of an Alaska bison, etc. Specimens of Cretaceous and Tertiary invertebrates and plants from the Coal series for exchange.

Mineralogy. 4000 specimens of Washington minerals, arranged according to Dana.

Economic and historic geology. 2000 specimens of ores of gold and silver; other ores, such as iron, copper, lead etc., 600; minerals, 2500; coals, including all varieties, 100; building stones and clays, 50; 300 specimens illustrative of the state's geology.

Zoology. Small collection of mounted mammals, mostly local species; considerable collection of mounted birds, mostly indigenous species or from Alaska; 100 specimens of mounted fishes; fairly complete series of the marine invertebrates of Puget sound, specially Mollusca and Echinodermata; miscellaneous collection of marine invertebrates from various parts of the Pacific coast and elsewhere; a collection of many thousands of insects. Limited number of specimens for exchange.

Botany. 4000 specimens from Washington; 500 from Michigan; 2000 from Alaska.

Ethnology and anthropology. Material collected by the state for exhibition at the World's Columbian exposition and afterward donated to the museum. It illustrates the industrial life of the local Indian tribes.

Vashon college, Burton. No report.

WEST VIRGINIA

West Virginia university, Morgantown. S. B. Brown, *curator*.

Paleontology. 2000 specimens: 500 genera, 700 species; coal plants and other Carboniferous fossils well represented; the original fossil plants from which the plates in the volume on the Permian flora of Pennsylvania were made.

Mineralogy. 1300 specimens, 400 mineral species. Economic minerals well represented.

Historic and economic geology and lithology. 500 specimens: building stones and mining exhibits.

Zoology. Working collections.

Botany. 3000 specimens: mainly the flora of West Virginia.

Ethnology and anthropology. 500 specimens: ancient stone weapons and utensils.

WISCONSIN

Beloit college, Logan museum, Beloit. George L. Collie, *curator*.

Paleontology. 1500 specimens including fossils from all the geologic periods. The Trenton group is well represented, as a fine section of the Trenton limestone is exposed at Beloit, and the collection contains many type specimens from these strata. The Mesozoic formations are also well represented by European forms, mainly ammonites; the Tertiary by European forms. Many specimens from the Trenton group for exchange; also material from the Mesozoic and Tertiary of Europe.

Mineralogy. 600 specimens designed to illustrate as fully as possible Dana's *Textbook of mineralogy*, and particularly rich in quartz and calcite, mainly from Wisconsin. Calcite is the only material offered for exchange.

Historic geology. Ward's series of typical specimens from New York state.

Lithology. The series of specimens issued by Krantz of Bonn illustrating Rosenbusch's *Manual*, and that issued by Sturtz of Bonn, illustrating the typical massive rocks; also a series issued by Kuntze of Iowa City illustrating typical American localities has been added recently.

Economic geology. 800 specimens: a series of specimens illustrating the chief ore bodies of the west; a large collection of ores obtained from the World's Columbian exposition, illustrating the occurrences in Australia, Canada and Turkey. Many duplicates of ores from various parts of the world for exchange.

Zoology. The Williard zoologic collection of 1000 specimens, representative of the birds, and to a less extent of the mammals of Wisconsin; 200 species of birds eggs in storage; and a large collection of shells not well labeled. Many bird skins for exchange.

Botany. 1500 specimens: a herbarium of Wisconsin flowering plants; the Ellis collection of fungi.

Ethnology. 2500 specimens: a large number of mortars and pestles, and mealing stones; Mound Builders and modern Mexican pottery; aboriginal tools, spear and arrowheads, among which are many obsidian pieces; numerous articles of adornment, pipes,

war clubs, hammers, axes, etc., a few copper implements, including two Aztec copper bells; Indian clothing and implements; some bone implements from remains of the Lake Dwellers, and stone and bronze implements from European localities; also a collection of 3500 coins and 112 casts of antique Grecian sculpture.

On the exchange list are arrow and spearheads from various localities, obsidian flakes from Mexico, perforated stones from South Africa, pottery from New Mexico and Arizona, broken pottery, etc. from the shell mounds of Japan, and Cliff Dwellers pottery.

The museum also possesses a large collection of postage stamps.

Lawrence university museum, Appleton. D. P. Nicholson in charge.

Paleontology. Small collection of fossils representing the Devonian, Silurian and Ordovician.

Mineralogy. Fair working collection of minerals and rocks.

Geology. A duplicate set of the collections made by the state geological survey of 1879 and some succeeding years.

Zoology. 150 mounted animals and bird skins, and a set of shells, all collected by Dr J. J. Brown of Sheboygan, and amounting to several hundred species with a considerable number of duplicates.

Ethnology and anthropology. Collection of miscellaneous curios.

Milton college museum, Milton. Ludwig Kumlien is in charge of the museum, except the ethnologic collections, which belong to Willis P. Clarke.

Paleontology, mineralogy and geology. 4000 specimens not well arranged and grouped, of a wide distribution, though Wisconsin is best represented.

Zoology. 30 mounted specimens of as many species of Wisconsin mammals; 400 mounted specimens of Wisconsin birds; 200 specimens, mostly alcoholic, of Wisconsin reptiles, amphibians and fish; 500 alcoholic specimens of marine invertebrates, and 2000 insects. A private collection of more than 6000 skins of animals and birds, also one of the eggs of 500 different species

of birds, are accessible to the students. Bird skins, birds eggs, and Wisconsin mammals for exchange.

Botany. A herbarium of 2000 species, nearly all Wisconsin forms, and mostly from Rock county; 200 to 300 mounted specimens of arctic algae and lichens.

Ethnology. A private collection, general in scope, of several thousand specimens, but more representative of the Wisconsin Mound Builders than of any other people or time.

The museum is for the purpose of giving to students an opportunity to study, as far as is possible, the entire range of natural science, and contains various skeletons, preparations, etc., not enumerated above. The mounted specimens are mostly local, except the private collections mentioned.

Milwaukee public museum, Milwaukee. Henry L. Ward, *custodian and secretary*; Carl Thal, *assistant custodian and assistant secretary*; William B. Brickner, *special clerk*; Charles Brandler and George Shrosbree, *taxidermists*; John F. Fidlín and Paul C. Rohde, *taxidermist apprentices*; Herbert Clowes, *landscape modeler*; Charles E. Brown, Hans Sauer, Olive C. Wheeler and Lydia Nehrling, *attendants*.

Paleontology. 14,459 specimens, the Niagara and Hamilton groups being best represented.

Mineralogy and geology. 6419 specimens.

Historic geology. Stratigraphic and paleontologic series included in enumerations above.

Zoology. 160,005 specimens: collections of mammals, birds, reptiles, fishes, shells, butterflies and beetles, corals, sponges, etc.; mounted groups of Wisconsin and North American birds and mammals are given special prominence with some extralimital species such as orang-utans, etc., also shown in groups.

Botany. 20,656 specimens: illustrating the flora of all parts of the world, but specially of Wisconsin.

Anthropology. 27,144 specimens.

Library. 9258 bound books and volumes of pamphlets, all treating on natural history subjects.

Northwestern university, Watertown. No report.

Provincial seminary of St Francis, St Francis. Small general collection of 1500 specimens.

Ripon college, Ripon. C. Dwight Marsh, *professor of biology*, in charge; W. S. Leavenworth, *professor of chemistry and physics*, in charge of mineralogic collection.

Paleontology. 1000 specimens, mainly from New York and Wisconsin, including one of Prof. Chamberlain's duplicate collections made by the Wisconsin geological survey.

Mineralogy. 2000 specimens forming a fairly complete typical series of mineral species and including the Barber collection of material, chiefly from New England; the Walcott collection, mainly from New England and New York; also a specially good collection of Lake Superior copper ores and Wisconsin iron ores.

Lithology. Not extensive.

Zoology. Collections are representative of most divisions of the animal kingdom. The best are those of echinoderms and crustaceans. There is a specially large collection of microscope slides and alcoholic specimens of Copepoda. Some material for exchange.

Botany. 1500 specimens of phanerogams and ferns.

Ethnology. A few stone and copper implements from Wisconsin.

University of Wisconsin, Madison. E. A. Brogè, *acting president*; William H. Hobbs, *mineralogy and petrology*; J. Morgan Clements, *geology and paleontology*; William S. Marshall, *zoology*; W. S. Miller, *vertebrate anatomy*; R. A. Harper, *botany*. The university museums comprise the geologic and mineralogic museum, the biologic museum and herbarium which occupy respectively the second and third floors of the south wing of Science hall.

Paleontology. Collections include that of the Wisconsin Academy of sciences, arts and letters, containing the type fossils described in the volumes of the first geological survey of Wisconsin; the Powers collection of Wisconsin Silurian fossils; and the systematic collection of fossils and casts of fossil forms belonging to the university. The type fossils of the Wisconsin academy are arranged in a special case in the geologic and mineralogic museum; the other specimens are systematically distributed in a number of cases.

Mineralogy. 34,100 specimens: the Henry collection of 30,000 specimens, which is particularly rich in minerals from the zinc and lead region of southwestern Wisconsin; a systematic mineral collection of 3000; and a systematic collection of crystals numbering 1000; also 100 oriented sections of minerals.

Economic geology. A metallurgic collection of 5000 specimens is exhibited.

Geology and lithology. 26,930 specimens; 13,900 microscopic slides: a set of the Rosenbusch collection of typical rocks, chiefly European, with a number of microscope slides, 550 specimens; 600 sections from the type rocks of the Wisconsin geological survey; the Brooks collection of 150 specimens from the Menominee region of Michigan; 230 from the Archean formations of Missouri; a general collection of 1000 crystalline rocks; a series of 500 Cambrian and post-Cambrian rocks and relief models to illustrate geologic and topographic features.

In Science hall, in condition for easy reference, is a large collection of rocks from representative crystalline areas of North America, belonging to the United States geological survey. The collection numbers over 40,000 specimens and 16,000 thin sections. Of these, 30,000 specimens and about 12,000 thin sections are of rocks from the Lake Superior region; 3000 specimens and 300 thin sections of New England crystallines; and the remainder from other typical crystalline areas of North America. In this building there is also located the following collections; 1500 specimens, chiefly from European localities, and 1000 microscopic slides in the private collection of crystalline rocks of the professor of mineralogy and petrology; special collections of engineering specimens and the collection of Wisconsin clays and building stones made by the Wisconsin geological survey.

Zoology. 50 skeletons and skulls; 80 mounted birds and about 100 skins; 100 species of echinoderms; 75 specimens of invertebrates; 1400 species of shells; both Ward's and Blaschka's series of models of invertebrates; and a good set of embryologic models; also good set life histories of insects both alcoholic and dry.

Botany. 10,000 sheets of phanerogams and vascular cryptogams from outside the state, and 3000 to 4000 sheets from with-

in the state; 7000 labeled specimens of Musci, including all the more important American forms; large collections of fleshy and parasitic fungi; a few exsiccatae of American algae and lichens; a small series of American woods; a small series of Brazilian woods; Hough's sections of American woods, and a number of papier-maché models illustrating the organs and structure of flowering plants.

Wisconsin academy of sciences, arts and letters, Madison. Ernest B. Skinner, *secretary*.

This academy has no natural history collections except a few fossils which are included in the collections of the University of Wisconsin.

WYOMING

University of Wyoming museum, Laramie. Wilbur C. Knight, *curator*.

Paleontology. 3000 specimens: good collection of the invertebrates from the Jurassic and Cretaceous formations of the Rocky Mountains of the United States; one of the largest collections of Jurassic dinosaurs from American localities in the world and the largest collection of Western Jurassic swimming saurians known. This collection contains type material as follows: *Ceratodus americanus* and *robustus*, *Megalneusaurus rex*, (type genus and species); *Cimoliosaurus laramiensis*; *Plesiosaurus shirleyensis* and *Cycadella*, a new genus of fossil cycad and 21 species. There is a lot of material in the Jurassic collection awaiting description. Duplicates of vertebrates and invertebrates offered for exchange.

Mineralogy. 700 specimens. Duplicates of Wyoming minerals for exchange.

Economic geology and lithology. 1700 specimens the most of which relate to the formations of the Rocky Mountains. Duplicates of Wyoming rocks for exchange.

Zoology. 850 specimens; in this collection there are about 550 bird skins representing the fauna of Wyoming.

Botany. The Rocky Mountain herbarium, Aven Nelson, curator, contains 40,000 specimens and the greatest number of

Rocky Mountain plants in any herbarium west of the Mississippi river.

Ethnology. 420 specimens of relics of the aboriginal inhabitants of Wyoming.

CANADA

BRITISH COLUMBIA

Provincial museum, Victoria. John Fannin, *curator*; F. Kermode, *taxidermist*; D. Withrow, *caretaker*; E. Anderson, *floor-walker*.

Paleontology. 3076 specimens.

Zoology. 11,659 specimens.

Botany. 564 specimens.

Ethnology. 1663 specimens.

Owing to the limited space for exhibition, this museum does not make exchanges. It is reserved almost exclusively as a provincial museum.

MANITOBA

Historical and scientific society of Manitoba, Winnipeg.

Paleontology. A few interesting local fossils.

NEW BRUNSWICK

Natural history society of New Brunswick, St John.

This collection includes those of the Mechanics institute. These are kept separate, and include that of Dr Gesner (rocks, minerals and fossils) made when he was employed on the geologic survey of New Brunswick; also some of Hartt's fossil insect types.

University of New Brunswick, Fredericton. L. W. Bailey in charge.

Paleontology. Cambrian, Cambro-Silurian, Silurian, Devonian, Carboniferous, and Quaternary formations; fossils of New Brunswick. A number of types of Cambrian fossils described and named by Dr G. F. Matthew from the rocks of St John; the types of Devonian fossils established by Dawson and Hartt from Carleton near St John, and fishes from the shores of Bay of Chaleurs; fossil fishes, Devonian, from the Albert mines; various mollusks and starfishes and a large fresh-water fish, Quaternary; fossils from Nova Scotia, including Silurian, Eo-De-

vonian and Carboniferous; fossils of Canada, from collections of the geological survey; American fossils, chiefly from Cincinnati group, and Lower Carboniferous; European fossils, chiefly Mesozoic and Tertiary, obtained by purchase.

Mineralogy. A general collection; a special collection of New Brunswick minerals.

Geology. Collections of Canadian rocks, chiefly Laurentian (St Lawrence, Saguenay, etc.) and Huronian; New Brunswick rocks, one series arranged according to age; another as illustrative of counties.

Zoology. The zoologic collections consist of 1) skulls of man, Quadrumana, Carnivora, Herbivora, Cetacea, Rodentia, Insectivora—with a few entire skeletons; 2) a small collection of mounted birds and mammals; 3) a collection of birds eggs identified and catalogued by Tappan Adney, New York; 4) about 200 numbered and catalogued fishes in alcohol from collections of United States fish commission; 5) a collection of marine invertebrates in alcohol from collections of United States fish commission; 6) collection of marine invertebrates, crustaceans, echinoderms, corals and sponges from Museum of comparative zoology, Cambridge Mass. and National museum, Washington D. C.; 7) a general and special conchological collection; 8) a collection of reptiles in alcohol from Boston society of natural history.

Botany. The botanical collections consist of 1) a collection of New Brunswick phanerogams and ferns, made by Dr James Robb and arranged on the Linnaean system; 2) a collection similar to the above but made by Prof. L. W. Bailey and arranged upon the natural system; 3) a collection of North American phanerogams from the herbarium of Prof. W. W. Bailey, Providence R. I.; 4) a collection of mosses, lichens and fungi; 5) a collection of diatoms, confervae, etc. mounted for the microscope.

None of the above collections are large, and additions to any of them would be very welcome.

Archeology. Collections of prehistoric relics from New Brunswick; stone weapons and utensils, pipes, pottery, etc.

NEWFOUNDLAND

Museum of the geological survey of Newfoundland. See Addenda, p. 223.

NOVA SCOTIA

Acadia college museum, Wolfville. Ernest Haycock in charge.

Paleontology. 500 to 600 specimens: a working collection representing all geologic horizons, but richest in Carboniferous and Devonian forms; a cabinet collection put up in England, representing in a manner the whole range of English geology, and a collection of corals from Ontario, and Silurian forms from Gaspé and Anticosti.

Mineralogy. Several hundred specimens: a collection of several hundred from Ottawa; a large collection purchased of Ward & Howell; and a series of the zeolites from the trap rocks of Nova Scotia.

Historic geology and lithology. Series of specimens illustrating the rocks of New York state and typical rocks from all parts of the world, purchased of Ward & Howell; and a representative series of Canadian rocks.

Economic geology. 300 specimens: ores purchased of Ward & Howell; and collections of gold-bearing quartz, antimony sulfid, manganese dioxid and other ores of Nova Scotia.

Zoology. A few mammals of Nova Scotia; a small collection of birds; a large collection of unios and specimens of shells of nearly all the marine orders.

Botany. A herbarium containing many species of plants of Nova Scotia and New Brunswick, prepared by G. U. Hay, of St John, New Brunswick.

Ethnology. Indian arrowheads and axes; bows and arrows from the Canadian northwest, and from India; weapons and domestic utensils from India and Burmah, and numerous articles from all parts of the world, specially from Hudson bay region and from China and Japan.

This museum is considered the most instructive and attractive in Nova Scotia.

Dalhousie college, Halifax. No report.

King's college, Windsor. Prof. Vroom, *acting curator.*

Paleontology. W. B. Almon collections, a few fossils from Scotland; Silurian and Devonian fossils from Arisaig, N. S.; a small collection of Australian fossils and Silurian and Devonian

fossils from Great Britain. The museum has a few specimens for exchange.

Mineralogy. A good collection of Nova Scotia minerals.

Historic and economic geology and lithology. A fair working collection.

Zoology. The museum has nothing of importance in this department.

Botany. Cogswell herbarium, phanerogamous and cryptogamous plants of Great Britain; Ball herbarium, 250 Nova Scotia plants; Strange herbarium, plants from India; Gossip herbarium, small collection from Scotland; McMorine herbarium of over 1000 Canadian and United States plants.

Ethnology. This collection consists of Maori clothing, Zulu weapons and Tahiti carved work.

A few specimens of historical (provincial) interest are also contained in the museum.

Provincial museum, Halifax. Harry Piers, *curator*.

Paleontology. Nova Scotian fossils, chiefly Carboniferous; specimens illustrating the late Dr D. Honeyman's writings and some type specimens.

Mineralogy. A general collection and a special (Nova Scotian) collection. Zeolites well represented.

Historic and economic geology and lithology. Collections illustrating local (Nova Scotian) historic and economic geology and lithology and specimens illustrating the late Dr D. Honeyman's writings on the geology of Nova Scotia. Also a general lithologic collection.

Zoology. Collections of Nova Scotian mammals, birds, birds eggs, reptiles, batrachians, fishes, and invertebrates. Also type specimen of *Sthenoteuthis megaptera* (Verrill) (large broad finned squid).

Botany. An herbarium of Nova Scotian plants (including some algae); collection of Nova Scotian woods; large series of water-color paintings of Nova Scotian wild flowers; Nova Scotian grains, grasses and fruits.

Ethnology and anthropology. Relics of the stone age in Nova Scotia; specimens illustrating the implements etc., at present used by the Micmac Indians. Foreign ethnologic and anthro-

pologic material is at present stored in boxes for want of room for their proper display.

There are also in this museum specimens illustrating various industries of Nova Scotia; numismatic collection (ancient and modern coins and casts) with descriptive manuscript catalogues; some local historic specimens; and a few oil portraits of merit. Connected with the museum is the Provincial science library.

ONTARIO

Geological survey of Canada, Ottawa. Robert Bell, *acting director*.

The most complete collection known of specimens illustrative of Canadian geology, zoology, botany, archeology and ethnology.

Paleontology. 16,000 Canadian specimens classified and exhibited, representing 4600 species, 1000 of which are types described by E. Billings, and about 400 types described by J. F. Whiteaves; a number of types of Cretaceous and Tertiary plants described by Sir J. William Dawson; Cretaceous vertebrates described by Prof. H. I. Osborn and Lawrence M. Lambe; also types of species established by Prof. E. D. Cope, Dr S. H. Scudder, Prof. T. Rupert Jones, A. H. Foord, Prof. H. A. Nicholson, E. O. Ulrich, W. R. Billings and others; unique collection of Ordovician crinoids, etc., from Ottawa and vicinity; Devonian fishes from the Bay of Chaleurs; original specimens of *Eozoone canadense*.

Mineralogy and lithology. 7000 Canadian specimens catalogued and on exhibition; Madoc and Thurlow meteorites.

Zoology. Representative specimens of nearly all the known birds and mammals of Canada.

Botany. The most complete herbarium extant of Canadian plants. A collection of the woods of Canada and of photographs of her forest trees.

Hamilton scientific association, Hamilton. The association has some interesting local fossils.

Kingston school of mining, Kingston. The museum is in charge of the several professors of geology and mineralogy.

Paleontology. The collection of Canadian fossils which was exhibited at the World's Columbian exposition by the geologic

survey department of Canada, and afterward presented to this school.

Mineralogy. 10,000 specimens, specially arranged to illustrate the lectures on descriptive, physical, and economic mineralogy. Many duplicates for exchange, including zircon, sphene, apatite, etc.

Historic geology and lithology. 4000 or 5000 specimens. Many duplicates for exchange.

This institution is affiliated with Queen's college, and the collections are used jointly.

Ontario agricultural college, Guelph. James Mills, *president*; William Lockhead, *curator and professor of biology and geology*.

The museum consists of a series of cases containing the most important minerals found in rocks; a series of 16 cases representing the characteristic fossils found in the geologic systems represented in Canada.

Perth collegiate institute museum, Perth. William Hardy, *principal of the institute*, and H. S. Rosevlar, *science master*, in charge.

Paleontology. Some trilobites, lamellibranchs and brachiopods from the Devonian formations; some Silurian cephalopods and other material, as yet unclassified.

Mineralogy. 400 specimens: iron and copper ores from eastern Ontario; copper and nickel ores from Sudbury; phosphate, mica and asbestos from the Perth district, and specimens of nearly every variety of silicates from the Laurentian district near Ottawa.

Lithology. 800 specimens: chiefly of massive eruptive and crystalline rocks; also a collection of concretionary forms.

Botany. 300 specimens of the flowering plants of eastern Ontario.

Provincial ethnological museum, Toronto.

Zoology. 400 specimens vertebrates, mollusks, insects of Ontario.

Botany. 500 specimens Ontario plants.

Ethnology and anthropology. 900 specimens representing Iroquois, Blackfoot, Blood and Kwakiutl Indians of Canada—Eskimo, Navajo, Zuni, Pima, Poma. Life masks of British Columbia and Washington Indians. Collections from China,

New Hebrides, Paraguay and Africa. 300 busts of European and United States scholars and celebrities. 2000 archeological specimens, photographs, paintings, etc. illustrative of people, mainly of Ontario, Mexico. Southeastern United States, Costa Rica and other countries are represented.

Queen's college and university museum, Kingston. James Fowler in charge.

Paleontology. 5000 specimens of general distribution.

Mineralogy. 3600 specimens from various sources.

Historic geology. The Rev. Andrew Bell collection of 1000 specimens illustrating a north and south stratigraphic section across the province from Lake Erie and a series of 500 specimens illustrating a stratigraphic section across the Ottawa river.

Lithology. An extensive collection which together with other collections in this department, is stored in the school of mining and agriculture in connection with the university.

Zoology. 3146 specimens: 26 mounted mammals; 130 mounted birds; 40 specimens of fishes; 200 alcoholic preparations and 150 dried specimens of invertebrates; small collections of reptiles and of insects, and 2600 mollusks.

Botany. 9450 mounted sheets: illustrating 1200 genera and 3650 species; a private herbarium of 14,731 sheets illustrating 2157 genera and 8650 species. Several thousand duplicates for exchange.

Ethnology. 500 specimens: a collection of Indian relics; a few hundred articles from China, Japan, the Pacific islands, Turkey, India and other countries.

University of Toronto, Toronto. GEOLOGICAL AND MINERALOGICAL MUSEUM. A. P. Coleman, *professor of geology*, curator; T. L. Walker, *professor of mineralogy*.

Paleontology. General collection for teaching purposes, 10,800 specimens. Pleistocene 2500 specimens, 227 species; the Townsend collection, 6400 specimens, 820 species. There is in addition a collection of fossils in the biological museum to illustrate systematic geology.

Mineralogy. 7125 specimens: Ferrier collection, 3700 specimens; general collection, 1400 specimens; students working col-

lection, 2025 specimens. The Ferrier collection of minerals is temporarily placed in the biological museum.

Petrography. 2810 specimens: 1440 Canadian rocks. 620 specimens in general collection and 750 specimens for students use.

Economic and structural geology. 390 specimens. Bureau of mines. Collection of economic rocks and minerals, 2000 specimens; building stones, 200 specimens; collection of 245 specimens to illustrate applied chemistry.

BIOLOGICAL MUSEUM. R. Ramsey Wright, *professor of biology*, in charge; B. A. Bensley, *assistant curator of zoological collections*; W. H. F. Addison, *temporary catalogue assistant*; A. Pride, *sub-curator and preparator*.

Paleontology. A small collection of animal fossils, arranged in ascending series, as a diagram to the biologic student of the succession of the fossiliferous formations of Europe and America. Specimens and models of fossils are also incorporated in their proper systematic position, specially of such forms as have a high morphologic and philogenic interest.

Zoology. 1100 catalogue entries of mammals; 3500 of birds and 900 of reptiles. The museum is rich in models and preparations illustrative of anatomy and animal development.

Botany. Herbarium and collection of models, chiefly by Brendel. The space now temporarily occupied by the university mineral collections is to be devoted to botanical collections.

The museum is primarily intended to supplement the teaching in the biologic department. It affords a floor space of 7500 square feet.

ETHNOLOGICAL MUSEUM. G. W. Wrong, *professor of history*, in charge. This museum is in the main building of the university and contains a fair collection of skulls including ancient Egyptian and Roman skulls and models of famous skulls of importance in ethnologic investigations—The Neanderthal, Cro-Magnon, etc. There are paleolithic implements from the English and French drift. The feature of the greatest interest is the collection of stone implements from various parts of Canada, specially of the district in which Toronto is situated.

Victoria university museum, Toronto. N. Burwash, *president*.

Paleontology. 2000 species of European fossils principally purchased from Krantz, chiefly Corniferous to Quaternary. About 1000 species chiefly Paleozoic, of Canadian and United States formations.

Petrography. 500 specimens of European and Canadian rocks.

Mineralogy. 1000 specimens of European and Canadian minerals.

Anthropology. The museum also has a very fine meteorite weighing nearly 400 pounds worshiped by the Crees for many generations as a divinity, a small collection of Indian antiquities from Ontario, Manitoba and British Columbia, some from the Pacific Islands and a very valuable collection from Japan including ancient pottery, arms, musical instruments and articles illustrating the life of the aborigines of the northern islands and the old Japanese civilization.

A collection of Egyptian antiquities includes a mummy about 600 B.C., various ancient images, hieroglyphic inscriptions on stone, wood and papyrus, ancient glass and pottery.

The collection of Indian antiquities has been recently enlarged by the purchase of dress, arms, utensils, drums, conjurers implements, totems, stone implements and other material from the Piegans, Blackfeet and the Indians of Alaska.

QUEBEC

Laval university, Quebec. J. C. K. Laflamme, *curator*.

Paleontology. General collections illustrating all formations, specially rich in Canadian Silurian and Devonian forms which have been identified and arranged by E. Billings and Dr Ami. 400 Niagara fossils presented by C. C. Grant and a collection of the fossils of Quebec presented by Dr J. M. Ahearn. Mesozoic and Tertiary fossils including a collection from Paris presented by the Abbé Baret of Ablainville; casts of protichnitis from the Potsdam of Canada and reptilian tracks from Turner's Falls.

Mineralogy. 4000 specimens. The old Quebec seminary collection with many additions arranged by Dr Thomas Sterry Hunt. A collection made for the Quebec seminary by the Abbé Haüy. Collection of exclusively Canadian minerals and sets showing

hardness and other properties; a collection of crystals presented by the Paris school of mines.

Lithology. A collection of rocks from the Paris museum of natural history prepared by Stanislaus Meunier; collections of Canadian rocks.

Economic geology. Copper ores from eastern Canada; iron ores from Leeds, St Urbain and Saguenay; auriferous quartz from Beauce; crude and manufactured crysolite from Thetford and Coleraine and a series of Canadian phosphates.

Zoology. General collection including many Canadian mammals.

Botany. Herbarium of 10,000 specimens including collections from Canada and the United States; collections from the Northwest presented by the Canadian geological survey. There are also collections of woods from Canada, France and from the English markets. Models of edible and poisonous mushrooms and specimens illustrating abnormal development, natural grafts and vegetable diseases.

McGill university (Peter Redpath museum), Montreal. B. J. Harrington, *honorary curator.*

Paleontology. Collections of Sir J. W. Dawson, largely Carboniferous and Devonian fossil plants; Microsauria and post-Pliocene mollusks of Canada; many types of species of Eozoon.

Mineralogy and geology. Many fine Canadian and foreign minerals and rocks; the Holmes and Miller collections of minerals.

Zoology. The Carpenter collection of shells, and other collections illustrating various departments of zoology.

Botany. The university herbarium, including the Holmes herbarium and other special collections.

Montreal college, Philosophy house, Montreal.

Mineralogy. A collection of minerals made by the Abbé Haüy, similar to that at Laval.

Natural history society of Montreal, Montreal.

Paleontology. General collection of fossils.

Mineralogy. The C. U. Shepard collection of minerals of 4000 specimens, presented by Dr Holmes; many good specimens of old finds.

SYNOPTIC LIST OF MUSEUM COLLECTIONS

Numbers refer to specimens except as otherwise stated.

NAME	PAGE	PHYSICAL AND CHEMICAL GEOLOGY	MINERALS	FOSSILS	ZOOLOGY			BOTANY		ETH- NOLOGY
					Insects	Other inverte- brates	Verte- brates	Crypto- game	Phanero- game	
UNITED STATES										
Alabama										
Ala. polytechnic institute mus. Auburn...	4	200	600	a				19 528	20 608	a
Geol. sur. of Alabama University.....	4	b 75 000	4 800	c 75 000	7 000	75	1 100	5 300		435
Arizona										
Univ. of Arizona Terr. mus. Tucson.....	5	3 000	2 500	.....		1 500		10 000		a
Arkansas										
Hendrix coll. mus. Conway.....	5	72	800	.....		100		3 500		
Univ. of Arkansas mus. Fayetteville.....	6	350	2 000	1 800		2 900				
California										
California academy of sciences.....	221	a	a	.....			d	110 000		2 200
Golden Gate Park mus. San Francisco...	6	.....	2 322	2 000		24 000		404	e	3 416
Leland Stanford jr mus. Palo Alto.....	7	e	e	e			e			e
San Diego soc. of nat. hist.....	8	a	a	a				1 500		a
Santa Clara coll. mus.....	8	2 300	1 000			400				a
State mining bureau, San Francisco....	9	.....	15 750	.....						a
Univ. of California, Berkeley.....	9	d	d	d						a
Univ. of Southern California, Los Angeles	12	1 000	3 700	2 950	a	20 350	1 000	3 100		730
Colorado										
Bureau of mines of Colorado, Denver....	12	a	a	a						
Colorado scientific soc. Denver.....	13	500	1 000	400						a
Colorado school of mines, Golden.....	13	1 800	29 000	2 440						a

a Small collection. b Including fossils. c Including geology. d Large collection. e Collections not enumerated.

a Small collection. b Including fossils. c Including geology. d Large collection. e Collections not enumerated.

Synoptic list of museum collections (*continued*)

NAME	PAGE	PHYSICAL AND CHEMICAL GEOLOGY	MINERALS	FOSSILS	ZOOLOGY			BOTANY		ETH- NOLOGY
					Insecta	Other inverte- brates	Verte- brates	Crypto- gama	Phanero- gama	
Colorado (continued)										
State agric. col. Fort Collins	13	a	a	50	40 000	.....	1 000	2 300	4 000	a
Univ. of Colorado mus. Boulder	14	1 500	1 175	500	.....	600	.....	4 000	.....	a
Connecticut										
Connecticut agric. college, Storrs	15	750	700	500	.....	10 000	.....	1 000	d	75
Peabody mus. nat. hist. Yale, New Haven	15	a	d	d	.....	d	.....	d	.....	d
Scientific ass'n of Meriden	16	1 200	2 000	.....	.....	.....	.....	.....	.....	.....
Trinity col. mus. Hartford	17	a	a	a	.....	a	.....	a	a	a
Wesleyan univ. Middletown	17	a	12 000	15 000	.....	110 000	.....	11 000	.....	8 000
Delaware										
Delaware college, Newark	18	300	600	250	.....	200	.....	1 000	.....	a
Soc. of nat. hist. of Delaware, Wilmington	19	.....	1 500	.....	a	.....	400	50 000	.....	.....
District of Columbia										
Catholic univ. of America, Washington...	19	.....	.....	.....	.....	.....	.....	.....	40 000	.....
Columbian univ. Washington	20	a	a	a	.....	a	.....	a	a	a
Georgetown univ. Coleman mus.	20	1 100	4 000	1 500	.....	10 000	.....	f	f	a
Howard univ. nat. hist. mus. Wash.	20	.....	800	500	.....	1 000	.....	2 200	.....	a
U. S. national museum, Washington.	21	75 789	35 433	444 569	1 846 000	1 449 881	467 366	526 751	.....	932 547
Florida										
John B. Stetson univ. De Land	26	a	a	a	.....	a	.....	a	.....	a
Georgia										
Emory college, Oxford	28	a	5 000	200	.....	a	.....	.....	.....	.....
Geol. survey (state museum) Atlanta.	28	d	980	.....	.....	.....	.....	400	.....	203

27	Mercer univ. Macon.....	6 000	a	2 500	.....	.....	.....	400	300	200	500
28	Univ. of Ga. Athens.....	a	a	a	.....	.....	.....	.....	.....	.....	a
28	Idaho										
	Univ. of Idaho, Moscow.....	a	1 000	250	16 000	.....	.....	270	a	10 000	100
	Illinois										
29	Augustana college, Rock Island.....	800	500	4 000	1 000	2 000	.....	.....	.....	3 000	1 500
29	Chicago acad. of sciences.....	1 000 {	3 500	10 000	{ 20 000	75 000	m	d	5 700	.....	1 000
32	Chicago univ. Walker mus.....	2 500	5 000	1 550 species	d	d	d	d	d	d	3 000
33	Col. of liberal arts, N. W. U. Evanston...	23 000	5 000	4 000 000	.....	18 000	4 600	20 000	.....	.....	8 000
34	Elgin scientific society.....	a	a	4 300	.....	.....	.....	.....	.....	.....	d
34	Field Columbian mus. Chicago.....	12 000	11 000	7 000	10 000	d	d	d	150 000	.....	.....
	Ill. state mus. of nat. hist. and geol. sur.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39	Springfield.....	.....	2 500	5 000	a	.....	a	.....	.....	.....	.....
39	Ill. Weal'n univ. Powell mus. Bloomington	d	d	d	1 000	15 000	1 000	1 000	1 000 {	6 000 {	1 140
41	Knox College, Galesburg.....	.....	1 250	2 100 {	2 000	2 500	400	.....	.....	.....	150
41	Lake Forest univ. mus.....	.....	.....	a	species	species	species	.....	.....	.....	.....
42	Northwestern college, Naperville.....	.....	600	300	f	f	f	f	14 000	a	350
42	Taylor mus. Blackburn univ. Carlinville..	{ 75 {	5 000	12 000	a	a	a	a	a	a	500
43	Univ. of Ill. Champaign.....	6 000	10 900	45 000	70 000	11 000	.....	.....	40 000	.....	800
	Indiana										
44	Franklin college, Gorbey collection.....	.....	1 000	35 000	.....	1 000	.....	.....	a	a	300
44	2 Hanover col. mus.....	a	a	a	a	a	a	a	a	a	a
45	Ind. univ. mus. Bloomington.....	1 500	1 000	5 000	3 000	10 000	d	d	500	1 000	1 000
45	Purdue univ. Lafayette.....	.....	1 000	4 000	6 000	.....	6 000	.....	5 000	.....	.....
46	Taylor univ. Walker mus. Upland.....	.....	1 000	500	.....	.....	100	.....	f	f	300
46	Wabash col. Hovey mus. Crawfordsville..	400	4 000	4 300	10 000	.....	825	1 500	30 000	.....	6 000
	Indian Territory										
47	Indian univ. Beacone.....	a	a	a	a	a	a	a	a	a	a

a Small collection. d Large collection. f Local collection. m Complete local collection.

1 2500 specimens. 2 500 specimens.

Synopsis list of museum collections (continued)

NAME	PAGE	PHYSICAL AND CHEMICAL GEOLOGY	MINERALS	FOSSILS	ZOOLOGY			BOTANY		ETH- NOLOGY
					Insects	Other Inverte- brates	Verte- brates	Crypto- gams	Phanero- gams	
Iowa										
Amity col. mus. College Springs.....	48	1 000		2 000		500		100		200
Davenport acad. of sciences.....	48	d	d	d		d		d	d	d
Iowa col. Parker mus. nat. hist. Grinnell	48	a	1 000	2 000		3 000		1 500	2 500	a
Muscatine acad. of sciences.....	49	g	g	g		g		g	g	g
State univ. of Iowa, Iowa City.....	49		30 000			100 000		175 000		800
Upper Iowa univ. Fayette.....	50	100	500	1 000	100	250	250	9 000	3 000	125
Wartburg teachers sem. & acad. Waverly	50	352	1 434	938		1 128		1 151		452
Kansas										
Baker univ. mus. Baldwin.....	51	500	4 810	21 156	32 798	9 000	1 800		7 789	900
Bethany college, Lindsborg.....	51	100	800	500		1000		1 500		2 000
College of Emporia, Emporia.....	52	200	300		250		250	250		
Kan. state agric. col. Manhattan.....	52		3 000		20 000	8 000				
Kan. Wesleyan univ. Salina.....	52	500	1 200	900	6 000	900	150	200		300
Midland col. mus. Atchison.....	53	500		800		120		1 000		a
Univ. of Kansas Lawrence.....	53	2 000	12 000	40 000		125 000		22 000		500
Washburn col. mus. Topeka.....	55	500	500	8 000		2 000		2 000		.....
Kentucky										
Kentucky univ. Lexington.....	55	200	500	500		250	1 375			300
Louisville public library.....	56	500	6 000	1 000			3 000	d	d	500
Ogden col. Bowling Green.....	56	200	2 000	2 000	a	a	a	d	d	d
State geol. dep't, Lexington.....	57	d	d	d	d	d	d	d	d	d
Louisiana										
Louisiana state university, Baton Rouge	58	a	a	a	150 cases	d	d	2 000		a
Tulane univ. Tulane mus. New Orleans..	58	300	5 000	3 000	d	d	d	45 000		

Maine									
Bates col. mus. Lewiston.....	59	a	a	a	a	a	a	a	a
Colby col. mus. Waterville.....	59	a	3 000	1 500	500	800	a	a	a
Kennebec hist. soc. Augusta.....	60	a	600	1 000	a	a	a	a	a
Univ. of Maine mus. Orono.....	60	600			2 500	15 000			150
Maryland									
Johns Hopkins univ. Baltimore.....	61	d e	d e	d e	d e	d e	d e	d e	d e
Maryland acad. of sciences, Baltimore...	63	a	5 000	500 000	a	1 500 species			10 000
Maryland geol. sur. Baltimore.....	64	d	d	d		2 500			800
Rock Hill college mus. Ellicott City.....	65	50	2 000	.....		25 000			3 000
Womans college museum, Baltimore.....	66	10 000	20 000	10 000	20 000				
Massachusetts									
Amherst college.....	67	2 000	10 000	40 000	15 000	4 000			1 500
Boston soc. of nat. hist. Boston.....	68	4 000	5 000	22 847	42 475	85 280			a
Cape Ann scientific & lit. ass'n, Gloucester.....	70	1 000	1 000	500	700	200			1 000
City lib. ass'n nat. hist. mus. Springfield.....	70	950	1 200	500	4 200	400			
Clark hall & Thompson biological lab.									
Williams college, Williamstown.....	71	750	1 250	900	a	a	a	a	a
Harvard univ. mus. Cambridge.....	72	d	d	d	d	d	d	d	d
Leominster public mus. Leominster.....	75	a	700	50	200	710			
Massachusetts agric. col. Amherst.....	75	a	2.5	300	9 000	a			50
Massachusetts institute of tech. Boston.....	77	10 000	10 000	10 000	30 000	a			
Peabody acad. of science, Salem.....	77	d	d	d	d	d	d	d	d
Smith college museum, Northampton.....	79	a	a	a	a	a	a	a	a
Worcester natural history soc.....	79	3 500	3 000	500	2 000	1 565	1 500		
Michigan									
Alma col. Francis L. Hood mem. mus.....	80	1 000	5 000	2 500	2 500	a			200
Detroit museum of art, Detroit.....	81	300	3 000	5 000	8 000	3 000 species			3 500
Michigan college of mines, Houghton.....	81	18 218	35 756	5 000	800	300			250
Michigan geol. survey, Houghton.....	82	12 000	.....	1 200					
Univ. of Michigan, Ann Arbor.....	82	800	6 000	95 040	d	70 000			d
Minnesota									
Carleton college, Northfield.....	84	.....	2 000	12 000	1 000	5 800			700
Gustavus Adolphus college, St Peter.....	81	1 000	500	800	500				

g Collection destroyed by fire.

e Collection not enumerated.

d Large collection.

a Small collection.

i See also p. 222.

Synoptic list of museum collections (continued)

NAME	PAGE	PHYSICAL AND CHEMICAL GEOLOGY	MINERALS	FOSSILS	ZOOLOGY			BOTANY		ETH- NOLOGY
					Insects	Other inverte- brates	Verte- brates	Crypto- gama	Phanero- gama	
Minnesota (continued)										
Hamline univ. mus. of nat. hist. St Paul.	85	1 000	a	1 000	1 000	2 350	1 750	3 300		200
Min. acad. of nat. science, Minneapolis.	86	500	2 500	1 500	1 500	h	4 800	h		1 500
Minn. geol. & nat. hist. sur. Minneapolis.	87	h	h	h	h	h	h	h	h	h
Univ. of Minnesota, Minneapolis	87	12 600	13 400	37 000	.....	.....	.....	275 000 sp'cin's 4 000 jars		
Mississippi										
Millsaps college museum Jackson	88	a	a	a	a	a	a	a	a	a
Miss. agric. & mech. col. agric. college...	88	.....	500	.....	10 000	70	a	2 000	4 000	
Univ. of Mississippi mus. of nat. hist. & geol. University	89	a	a	a	a	a	a	a	a	a
Missouri										
Bureau of geology and mines, Rolla	89	1 500	32 000	2 500	850		300	400	1 400	a
Drury college, Springfield	89	2 000	1 500	10 000	400		900	.....	500	350
Pritchett college museum, Glasgow	90	3 500	7 000	500						
Univ. of Mo. school of mines & metal. Rolla.	91	2 000	1 500	1 500						
Univ. of state of Mo. univ. mus. Columbia.	91	7 000	10 000	20 000		15 000				
Washington univ. mus. St Louis	92									
Montana										
Mont. col. of agric. & mech. arts, Bozeman.	92	.....	5 000	2 000		7 000		12 000		
Nebraska										
Creighton univ. mus. Omaha	93	a	a	a		a	a	a	a	a
Doane college biol. & geol. mus. Crete...	93	.....	600	350		700	450	2 500		150
Univ. of Nebraska, state mus. Lincoln...	94	d e	d e	d e		d e	d e	d e	d e	d e

New Hampshire									
94	Dartmouth col. Butterfield mus. Hanover.	18 200	2 000	a { 150	1 000 species	3 000	a	d	a
96	Keene high school museum.	a	2 000			3 000		500	
97	Keene nat. hist. soc.		1 000						
97	N. H. col. of ag. and mech. arts, Durham	5 000	1 500	300	20 000	500		2 000	4 000
New Jersey									
97	New Jersey geol. sur. Trenton.	i	i	i		i		i	i
97	N. J. state mus. Trenton		1 500	d		325		100	
98	Princeton univ. museums, Princeton.	5 240	76 000	5 000 species	20 000	d		d	d
102	Butgers col. G. H. Cook mus. N. Brunswick	2 600	11 700	5 750	d	d		d	d
New Mexico									
103	N. M. col. of ag. & mech. arts, Mesilla Pk		500	200	d	50		3 000	
New York									
104	Alfred univ. mus. Alfred	a	1 600	1 500	2 000	20 000		6 000	5 000
105	Am. mus. of nat. hist. New York.	d	d	d	d	d		d	d
110	Brooklyn inst. of arts and sciences, B'kin	a	3 000	7 000	130 000	12 000	16 200	40 000	
111	Buffalo soc. of nat. sciences, mus. & lib.	2 885	1 218	31 000	1 535	3 332	1 535	14 935	5 000
112	Buffalo state normal sch. mus.	50	300	400			150	400	
113	Caaisins college, Buffalo	550	800	1 000	2 500	450		1 600	
114	Colgate univ. mus. of geol. & nat. hist. Hamilton.	a	a	a	1 300	1 400		2 700	a
114	College of the City of N. Y. New York.	2 400	7 500	500		3 750		550	a
115	Columbia univ. mus. New York.	d	25 000	50 000	d	d	d	500 000	
116	Cornell univ. mus. Ithaca.	d	d	d	d	d	d	d	d
119	Glen Island mus. of nat. hist. N. Rochelle				4 300		500	500	a
120	Hamilton college, Clinton.	1 250	10 000	2 500	13 000	2 000	600	2 595	9 154
121	Hobart college mus. Geneva.	a	a	a		a		4 000	1 600
121	Long Island hist. soc. mus. Brooklyn.	a	200	292		2 000		3 000	
122	Nat. sci. ass'n of S. I. New Brighton.	a		a		600			
123	New York state museum, Albany.	3 000	4 300	1 000 000 {	3 000 {	61 786 {	4 338	44 000	d
128	New York univ. University Heights	9 500		16 000		d			
128	Niagara univ. museum		400	600		130		300	60
129	Polytechnic institute mus. Brooklyn.	500	3 000	1 000		1 000			100

10,000 specimens. a Small collection. d Large collection. e Collection enumerated. h Listed under Univ. of Minnesota. i Collection in New Jersey state museum.

Synopsis list of museum collections (continued)

NAME	PAGE	PHYSICAL AND CHEMICAL GEOLOGY	MINERALS	FOSSILS	ZOOLOGY			BOTANY		ETH- NOLOGY
					Insects	Other invertebrates	Vertebrates	Crypto- gams	Phanero- gams	
New York (continued)										
Rensselaer polytech. inst. mus. Troy....	129	3 000	5 000	1 500	10 000		400	5 300		a
St Lawrence univ. mus. Canton.....	130	2 300	4 000	1 000	1 000			a		a
Syracuse univ. of nat. hist.....	130	700	1 000	1 700	1 000			5 000		a
Union col. nat. hist mus. Schenectady....	131	1 500	4 500	3 000 {	375 species	2 860 species	600 species	2 400	700	
Univ. of Rochester.....	131	3 000	5 000	25 000	1 000			a		a
Vassar col. mus. Poughkeepsie.....	133	800	3 500	8 150	25 090			1 700		770
Ward's nat. sci. estab. Rochester.....	135	22 000	160 000	150 000	137 000			74		5 826
West Point min. and geol. cab.....	136	4 500	5 913	9 074	.....	.....	.....	.....	.....	a
North Carolina										
Davidson college museum.....	138	.....	4 000	3 000	800			df	df	df
North Carolina state mus. Raleigh.....	138	df	df	df	df					
North Dakota										
North Dakota agric. col. mus. Fargo.....	139	.....	400	a		350		a		50
Red River Valley univ. mus. Wahpeton...	140	.....	a	a		100		200		500
State univ. of N. D. mus. Grand Forks...	140	800	2 000	1 000		299		{ 440 species	1 200 species	650
Ohio										
Antioch col. Yellow Springs.....	141	a	500	10 000	4 000			600		a
Baldwin univ. mus. Berea.....	141	a	500	300	a			a		
Case sch. of applied science, Cleveland...	142	1 854	2 957	7 000	8 900			2 724		a
Cincinnati soc. of nat. hist.....	142	734	1 296	4 882	6 307			4 000		
Cuvier club of Cincinnati.....	143	.....	.....	.....	.....	
Heidelberg univ. Tiffin.....	143	a	a	a	a			a		a
Hiram college mus.....	144	100	1 200	1 000	1 000			a	a	2 000

Oberlin college mus.	144	{ 3 500 (trays) }	2 950 { (trays) }	5 700 (trays)	20 000	35 000	3 500
Ohio state univ. mus. Columbus	145	2 500	500	11 000	40 000	83 000	100 000
Ohio Wesleyan univ. Delaware	146	1 000	2 000	5 000	25 000	300	1 200
Otterbein univ. Westerville	147	a	a	a	a	a	a
Seio college.	147	800	3 000	.....	150	1 000	a
Urbana univ. mus.	147	a	a	a	a	a	a
Western Reserve univ. Cleveland	148	1 200	2 500	6 000	10 000	1 000	a
Oregon							
Oregon state agric. col. mus. Corvallis ..	148		1 000	6 000	75 000	10 000	325
Univ. of Oregon, Condon mus. Eugene ..	149	900	800		1 000	.....	.....
Pennsylvania							
Acad. of nat. sci. of Philadelphia	149	d 6 000 (trays)		36 000	126 000	870 000	91 400
Albright college, Meyerstown	151	a	775	700	1 300	500	10 000
Alleghany college, Meadville	151	a	10 000	a	5 150	f	300
Bryn Mawr college	152	2 500	950	35 000			100
Carnegie museum Pittsburgh	152	d	7 000	d	72 000 { species	16 070 { species	6 750
Geneva col. mus. Beaverfalls	153	a	a	a	a	a	a
Haverford college mus.	153	a	1 000	.....	4 000	1 500	a
Lafayette college mus. Easton	153	.....	.....	.....	.....	.....	a
Muhlenberg college, Allentown	153	400	500	600	500	d	d
Pennsylvania college, Gettysburg	154	3 000	6 000	.....	.....	3 000	.....
Pennsylvania geol. sur. Harrisburg	154	10 000	135	4 220	.....	6 000	.....
Pennsylvania state college, State College.	155	5 200	10 000	2 000	.....	5 500	d
1 The Philadelphia museums	156	d	d	d	15 000	d	d
Swarthmore col. mus.	157	300	700	200	d	d	d
Univ. of Pennsylvania, Philadelphia	158	4 000	12 000	15 000	1 612	2 000	50
Wagner free inst. of science, Philadelphia	164	.....	2 000	20 000	10 000	14 000	d
Washington & Jefferson col. Washington.	164	1 000	2 500	d	25 000	1 000	1 200
					2 000	500	800
Rhode Island							
Brown univ. Jenks mus. of zool. Provid'nce	165	500	5 000	10 000	25 000	.....	1 000
Mus. of nat. hist. Providence	166	a	1 200	750	1 200	4 800	5 000
R. I. col. of ag. and mech. arts, Kingston.	166	a	a	a	a	.....	a

d/Large local collection. f/Local collection.

d/Large collection.

a Small collection.

1 250,000 specimens.

Synoptic list of museum collections (continued)

NAME	PAGE	PHYSICAL AND CHEMICAL GEOLOGY	MINERALS	FOSSILS	ZOOLOGY			BOTANY		ETH- NOLOGY
					Insects	Other Inverte- brates	Verte- brates	Crypto- gams	Phanero- gams	
South Carolina										
Clafin univ. Orangeburg.....	167	300	3 000	250		1 500		1 000		1 000
College of Charleston.....	167	300	2 000	5 000	5 000		2 000	5 000		100
Furman university, Greenville.....	168	500	1 500	300	100	500				g
South Carolina college, Columbia.....	168	g	g	g	g	g	g	g	g	
South Dakota										
South Dakota geol. surv. Vermilion.....	168	j	j	j	j	j	j	j	j	j
State school of mines, Rapid City.....	168	1 200	3 000	900						
Univ. of South Dakota, Vermilion.....	169	850	700	1 125	200	2 000		2 000		a
Yankton college, Yankton.....	170	a	a	a	a	a	a	a	a	
Tennessee										
Cumberland univ. mus. Lebanon.....	170	600		1 500						
Fisk university, Nashville.....	170						a	a		
Maryville col. mus.....	170	200	1 000	750		300	500	2 000	478	410
So. western presbyterian univ. Clarksville.....	171	a	6 000	a		16 000		500		a
Univ. of Tennessee, Knoxville.....	172	a	a	a	d	a		30 000		800
Vanderbilt univ. Nashville.....	172	2 500	4 000	15 000		2 000		5 000		150
Walton univ. Nashville.....	172	50	400	100	18 000	1 000		300		
Texas										
Univ. of Texas, Austin.....	173	d	d	d	d	d	d	d	d	d
Univ. of Texas min. sur. Austin.....	175	d	d	d						
Utah										
Univ. of Utah, Salt Lake City.....	175	500	2 000	200		2 000		1 200		

Synoptic list of museum collections (concluded)

NAME	PAGE	PHYSICAL AND CHEMICAL GEOLOGY	MINERALS	FOSSILS	ZOOLOGY			BOTANY		ETH- NOLOGY
					Insects	Other inverte- brates	Verte- brates	Crypto- game	Phanero- game	
CANADA										
British Columbia	191	207	1 915	3 076		11 659		564		1 663
Provincial museum, Victoria.....										
Manitoba			f	f						
Hist. & sci. soc. of Manitoba, Winnipeg..	191									
New Brunswick			a	a						
Nat. hist. soc. of St John.....	191	a	a	a	d	d	d	d	d	d
Univ. of New Brunswick, Fredericton....	191	d	d	d						
Newfoundland			500	1 173	a	750	809	493		d
Mus. of the geol. sur. of N. F. St John's..	223	a								d
Nova Scotia										
Acadia college mus. Wolfville.....	193	d	a	600	d	d	d	d		a
Kings college, Windsor.....	193	a	a	a	a	a	a	a	a	d
Provincial mus. Halifax.....	194	d	d	d	d	d	d	d	d	
Ontario										
Geol. sur. of Canada, Ottawa.....	195	7 000		16 000						
Hamilton scientific ass'n, Kingston.....	195			f						
Kingston school of mining, Kingston.....	195	5 000	10 000	d						
Ont. agric. college, Guelph.....	196	a	a	a						
Perth collegiate inst. mus.....	196	800	400	a						
Provincial ethnological mus. Toronto....	196									
Queens col. & univ. mus. Kingston.....	197	d	3 600	5 000	2 950	400	198	300	500	2 208
								24 181		500

Univ. of Toronto.....	197	5 645	7 126	20 000	d	d	d	d	d	d
Victoria univ. mus. Toronto	189	500	1 000	3 000	d	d	d	d	d	d
Quebec										
Laval univ. Quebec.....	199	a	4 000	a	d	d	d	d	d	d
McGill univ. Peter Redpath mus. Montreal	200	d	d	d	d	d	d	10 000	d	d
Montreal col. philosophy house.....	200	.....	a	a	d	d	d	d	d	d
Nat. hist. soc. of Montreal.....	200	a	a	a	a	a	a	a	a	a

a Small collection. d Large collection. f Local collection. i Complete Canadian collection.

PUBLIC BOTANIC AND ZOOLOGIC GARDENS AND AQUARIUMS IN THE UNITED STATES

The desirability of this list has become evident during the compilation of the directory of museums as the collections maintained are in many instances supplementary to the museums and contain so much material of great value to investigators in botany and zoology.

From the information at present on hand only a very incomplete notice can be given. The tendency in most of the large cities seems to be to maintain collections of living animals and botanic departments in the public parks where the work has not already been undertaken by scientific societies.

DISTRICT OF COLUMBIA

National zoological park, Washington. Director, *ex officio*; S. P. Langley, *secretary of the Smithsonian Institution*; Frank Baker, *superintendent*; A. B. Baker, *property clerk*; W. H. Blackburne, *head keeper*.

The number of animals in the collection, June 30, 1902, 883; estimated value of animals, \$38,000.

Approximate number of specimens: mammals, 123 species, 506 specimens; birds, 72 species, 232 specimens; reptiles, 32 species, 145 specimens. The aquarium is fitted with 17 tanks and usually contains from 40 to 70 species of fish and invertebrates, represented by from 150 to 400 specimens. A small working library is maintained at the superintendent's office. Animals which die in the collections are sent to the United States national museum.

MINNESOTA

Board of park commissioners, Minneapolis. J. A. Ridgway, *secretary*.

A limited zoologic garden under the direction of the superintendent of public parks is maintained and contains 25 species, 166 specimens of mammals and 130 birds.

NEW YORK

Buffalo zoological garden, Buffalo. F. A. Crandall jr, *curator*.

The collections consist of the following animals: mammals, 35 species, 159 specimens; birds, 24 species, 67 specimens; reptiles, 6 species, 44 specimens.

Rochester zoological park, Rochester. William Bausch, *chairman of zoological committee*; C. C. Lang, *superintendent of parks*.

The collections consist of: mammals, 38 species, 141 specimens; birds, 80 species, 371 specimens; reptiles 3 species, 3 specimens.

The New York zoological society. THE AQUARIUM, Battery park. Charles H. Townsend, *director*.

The collections consist of marine and fresh-water life and include only such forms as can be shown to advantage in tanks. While fishes constitute the main feature of the exhibit, batrachians, reptiles and seals represent the higher forms of life. Ascidians, crustaceans, worms, mollusks, echinoderms, anemones and corals, are among the lower forms shown.

The New York aquarium has the largest buildings and the most extensive collections of marine and fresh-water life in the world.

NEW YORK ZOOLOGICAL PARK, Bronx. William T. Hornaday, *director*.

Collections of living animals: mammals, 141 species, 612 specimens; birds, 175 species, 1005 specimens; reptiles, 131 species, 1198 specimens.

These numbers are subject to constant change. New animal houses are now being constructed and collections will be extended as facilities for their accommodation increase.

New York botanical garden museum, Bronx park. N. L. Britton, *director*; D. T. MacDougal, *first assistant*; John K. Small, *curator of the museums*; P. A. Rydberg, Arthur Hollick, Marshall A. Howe, F. S. Earle, *assistant curators*; George V. Nash, *head gardener*; Anna Murray Vail, *librarian*; H. H. Rusby, *curator of the economic collections*; William J. Gies, *consulting chemist*; F. A. Schilling, *superintendent*; John R. Brinley, *landscape engineer*;

Walter S. Groesbeck, *clerk and accountant*; Cornelius Van Brunt, *honorary floral photographer*.

Paleobotany. The collection of 8000 specimens is mainly the property of Columbia university. It was begun by the late Prof. J. S. Newberry and in addition to the exhibition series, contains specimens from almost every section of the world and from every geologic horizon. It is specially rich in North American forms. The Triassic Cretaceous and Tertiary plants are represented by specimens collected by the Hayden exploring expedition, Missouri and Yellowstone rivers 1859-60; the McComb and Ives explorations of the Grand, Green and Colorado rivers 1859-61, and by an extensive suite of specimens from the clay beds of New Jersey, on which Dr Newberry based his *Flora of the Amboy clays*. An exceedingly interesting local series is shown which was collected by Dr Arthur Hollick on Long Island, Block Island and Marthas Vineyard. The fossil plants are arranged primarily on the sequence of the geologic time divisions and are designed to show the succession of plant life on the earth.

Economic botany. On the first floor of the building are 24 cases of drugs in two series, crude drugs and refined drugs. The crude drugs are arranged morphologically, as from roots, stems, bark, flowers etc. to the whole plant. Refined drugs are first divided into products, and these arranged in their natural families. In this section is shown a collection of local poisonous plants; 20 cases of woods and wood products; 12 cases of fibers, 9 cases containing crude fibers and their products, 2 cases of wood paper and straw paper; one case of cork; 12 cases of foods and food plants divided into three groups; 1 case of dry seeds and fruits, 2 cases of fleshy seeds and fruits, 3 cases of herbs or parts of herbs or woody plants other than seeds or fruit.

A collection of miscellaneous exhibits fills 20 cases as follows: 1 of turpentine and rosin; 3 of gums and resins; 2 of fodder plants; 1 of crude and refined sugars; 1 of tobacco; 2 of volatile oils, 1 of fixed oils; 1 of starches; 1 of chocolate; 1 of barley malt, beer and ale; 1 of grape juice and wines; 1 of cinnamon; 1

of spices; 1 of licorice; 1 of soap-making, insect powders and miscellaneous vegetable products.

The specimens throughout the economic museum are supplemented by plates, photographs and drawings.

Systematic botany. A general synoptic collection consisting of 72 cases occupies the second floor of the building. Typical specimens of plants occupy the backs of the cases while on the shelves are arranged photographs, drawings, flowers, fruits, woods, fossils, etc. The present installation is as follows: one case (the first) contains the myxomycetes or slime molds. The seven cases following this are devoted to the algae or seaweeds. The succeeding seven cases contain the various groups of the fungi. Three cases are devoted to the lichens, two to the hepatics, four to the mosses, three to the pteridophytes, three to the gymnosperms, six to the monocotyledons and 36 to the dicotyledons.

There is also a collection mounted on swinging frames of every species of plant known to grow naturally within 100 miles of New York. A unique exhibit, both suggested and presented by William E. Dodge, consists of 24 microscopes of special design showing a series of slides of cryptogamic plants.

The library and herbarium occupy the third floor. There are 13,000 volumes now in the library, about one half of which constitute the botanic library of Columbia university.

The herbarium contains 1,100,000 specimens, 700,000 in the Columbia herbarium and 400,000 in the garden herbarium. The latter collection is rapidly gaining in value and importance.

1 Garden herbarium. The specimens composing it have been derived from collections made in all parts of the world during the past few years (specially since the foundation of the garden) in addition to miscellaneous specimens and many rare sets of plants of earlier collections fortunately acquired through the accessions of the following collections:

The J. B. Ellis herbarium, of fungi.

The John J. Crooke herbarium, mainly North American.

The F. M. Hexamer herbarium, European and North American.

The H. E. Hasse herbarium, North America, largely Californian.

The Per A. Rydberg herbarium, North American and European.

The Lewis R. Gibbes herbarium, North American, mainly from South Carolina.

The Peter V. LeRoy herbarium, miscellaneous.

The Harry Edwards herbarium, North American, mainly Californian.

The Anna M. Vail herbarium, eastern North America.

The Francis E. Lloyd herbarium, North American, largely from Oregon.

The A. Vignier herbarium, mainly European and Mexican.

The E. C. Howe herbarium, North American, largely fungi.

The American museum of natural history herbarium, miscellaneous.

The Torrey botanical club herbarium, vicinity of New York city.

The T. F. Allen herbarium of Characeae.

The George V. Nash herbarium, miscellaneous, mostly American.

The A. Henry herbarium of Chinese plants.

The Elizabeth G. Britton, herbarium, eastern North America.

The Gustav Rampsperger herbarium, miscellaneous.

2 Columbia herbarium. The Columbia university herbarium was begun early in the last century by Dr John Torrey, and contains the material upon which his botanical writings, extending over half a century, were based. On this foundation the present Columbia herbarium was built. Mr John J. Crooke enriched it by two valuable collections: one, that of Prof. C. J. Meisner, of Basle, Switzerland, and the other that of the late Dr A. W. Chapman, of Apalachicola Fla. A few years later the mosses, and many of the hepatics and lichens accumulated by C. F. Austin, were incorporated in it, while the most recent acquisitions of great size and importance, are the most famous collection of mosses brought together from all parts of the

world by the late Dr J. G. Jaeger, of Switzerland, and the Morong herbarium. To this ample nucleus, Dr Torrey's successor, Dr N. L. Britton, while professor at Columbia, and his associates, added continually by securing collections from all parts of the globe, and by special collecting trips to various parts of America.

The conservatories consist of a range of 15 houses with about one acre of floor space. The construction throughout is in accordance with the most modern principles and the structures form the most elegant glasshouses in the world. Over 20,000 plants, representing 6000 species are now growing in the houses. The collections are arranged botanically as far as temperature conditions will permit. There is also a system of propagating and experimental greenhouses.

The outside collections are in the Herbaceous ground, the Fruticetum and the Arboretum. About 2700 species of herbaceous plants and over 300 trees represent almost all orders of plants containing hardy species.

The wild flora has been carefully conserved and includes over 600 flowering plants and about 2000 cryptogams.

The museum is a new specially designed building of Italian renaissance style, of Indiana limestone and terra cotta. It is specially equipped with all modern appliances for the comfort of those using it and is open to the public daily from 9 a. m. to 5 p. m. The library and herbarium are open to students. There are no regular courses of instruction but properly prepared students are given such guidance and assistance as they may need to prosecute investigations. Two courses of public lectures are provided during the year.

OHIO

Cincinnati zoological garden, Cincinnati. S. A. Stephen, *general manager*; W. Kesley Schaepl, *president*; Walter A. Draper, *secretary*.

The garden is situated 3 miles from the center of the city in an easily accessible locality. The natural landscape features

have been taken advantage of in adapting the garden to its present use. The garden is open the year around to visitors, a small admission fee is charged. The animals are housed in a number of specially designed buildings. There is also a clubhouse and restaurant. The collections include the following specimens: mammals, 643; birds, 691; reptiles, 176; total, 1510.

The lake and small ponds are well stocked with fish. A small library of reference books is maintained.

PENNSYLVANIA

The Highland park zoological garden, Pittsburg. William W. Bailey, *superintendent*.

About 200 specimens of monkeys, Herbivora, Carnivora, birds and reptiles.

The Zoological society of Philadelphia, Philadelphia zoological garden. Charles Platt, *president of the board of directors*; Henry C. Chapman, *corresponding secretary*; A. E. Brown, *superintendent*.

The collections consist of animals of the higher orders of vertebrates. 1465 species have been exhibited belonging to the following orders: mammals, 407; birds, 711; reptiles 304; batrachians, 43.

The society maintains a library for reference.

RHODE ISLAND

Roger Williams park zoological garden, Providence. A small collection of animals is maintained by the city park commission, the collection at present consists of: mammals, 20 species, 90 specimens; birds, 14 species, 225 specimens; reptiles, 1 species, 4 specimens. There is also a small reference library and museum.

Among those which are not otherwise noted are the following:

Missouri botanical garden, St Louis Mo. William Trelease, *director*.

National botanical garden, Washington D. C. William R. Smith, *director*.

Harvard botanical garden, Cambridge Mass. (Collections partly enumerated under Harvard university). George L. Goodale, *director*.

Buffalo botanical garden, John R. Cowell, *director*.

The Arnold arboretum, Boston Mass. C. S. Sargent, *director*.

The city of Detroit is now building an aquarium and maintains a zoologic garden.

There is also a collection of animals in Lincoln park, Chicago.

ADDENDA

Received too late to be inserted in their proper place in the text.

CALIFORNIA

California academy of sciences, San Francisco. Leverett Mills Loomis, *director of the museum and curator of ornithology*; H. H. Behr, *curator of entomology*; Alice Eastwood, *curator of botany*; John Van Denburgh, *honorary curator of herpetology*; Alfred L. Kroeber, *honorary curator of anthropology*; F. M. Anderson, *honorary curator of paleontology*; Charles Fuebis, *preparator of entomology*.

Paleontology. Small collection chiefly of invertebrate fossils. It contains a number of type specimens and is constantly growing.

Mineralogy. Several thousand including many rare specimens.

Economic geology. Collection small.

Zoology. An extensive collection representing all orders. Birds about 20,000 including several types; 4500 reptiles and batrachians with a few type specimens; 4000 fishes, 36 types; 45,000 insects with over 1000 types.

Much material for exchange.

Botany. 110,000 specimens. Every department of botany is well represented. The collection is of general distribution but particularly rich in Pacific coast N. A. plants, and contains the types of many species.

Specimens for exchange.

Ethnology. 2200 specimens from Alaska, California, South Sea islands and Japan, specially strong in Polynesia. The academy has a library of 11,000 volumes on natural history and publishes a series of proceedings (octavo) memoirs (quarto) and occasional papers (octavo).

MICHIGAN

Detroit Museum of Art, Detroit. A. H. Griffith, *director*.

Paleontology. 5000 specimens.

Mineralogy. 3000 specimens.

Economic geology and lithology. 300 specimens.

Zoology. 8000 insects, 60,000 mollusks and 700 specimens of other orders.

Botany. A collection of 3000 specimens.

Ethnology. 3500 specimens.

PENNSYLVANIA

Lehigh university, South Bethlehem.

Paleontology. 3000 specimens illustrating common genera. Paleozoic Mollusca and Brachiopoda best represented.

Mineralogy. 10,000 specimens included in the Roepper collection, a general collection of 3000 specimens; the Keim collection of 1000 specimens and about 300 other specimens and a practice collection of 2500 specimens.

Economic geology and lithology. 4000 specimens: illustrative collections from the Rocky mountains; ores of precious metals, copper and iron ores and coal; specimens of rocks from all parts of the world but chiefly from Europe and the United States. 400 specimens for exchange.

Zoology. 2500 specimens. The Werner collection of North and South American birds, nests and eggs, 600 specimens; the Packer collection of recent shells, mostly gastropods, 1000 specimens, and a synoptic collection of 2500 specimens.

Botany. A small collection, mainly microscopic sections.

Ethnology. 1000 specimens North American Indian weapons, clothing and utensils.

CANADA

Museum of the geological survey of Newfoundland, St John's.
James P. Howley, *director*.

Paleontology. 1173 specimens divided as follows: Archaean, 3 specimens of *Eozoon canadense*; Avalonian, *Arenicolites* and *Aspidella* from Newfoundland, *Oldhamia radiata* from Ireland. Cambrian; about 500; lower series well represented, many typical fossils from Newfoundland. Lower Silurian 200, Middle Silurian 150, Upper Silurian 40, some Devonian forms; Carboniferous 200. The above all from Canada and Newfoundland except as noted. Jurassic 25, England; Cretaceous 26, England and United States; Tertiary 32, Canada and United States.

Mineralogy. 500 specimens, chiefly from Newfoundland localities the remainder from various countries.

Economic geology. Specimens of granites, sandstones, marbles, serpentine, slates, clays, etc.

Lithology. A collection of rock specimens.

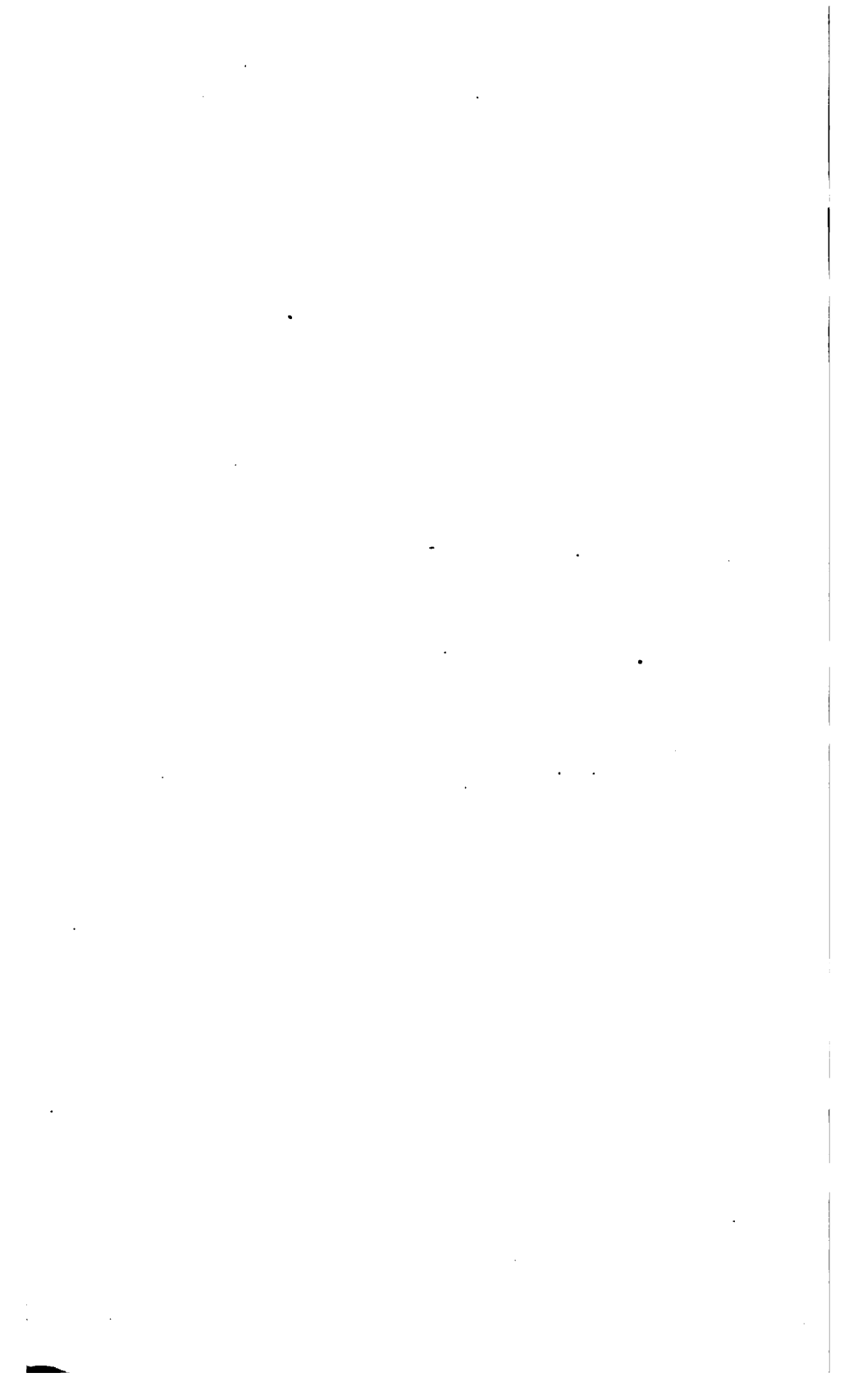
Zoology. 1659 specimens: 30 native and 12 Australian mammals. 150 native and 165 foreign birds; 50 native and 502 foreign fishes; 250 native and 500 foreign shells, a few native and many foreign insects.

Botany. 365 herbarium specimens; 28 native woods.

Ethnology and anthropology. Bones and other remains of the Boeothucs, the Indians of Newfoundland. Stone and iron implements, ornaments, drawings, etc. A few Eskimo and Micmac implements, ornaments and utensils.

A good set of fishery products including oils, fertilizers, preserved fish, etc. Models of fishing vessels and implements; photographs illustrating the fisheries industry; numerous photographs of mining, lumbering and natural scenery. A number of local historical relics and many others from foreign sources.

A few specimens in all departments except ethnology for exchange.



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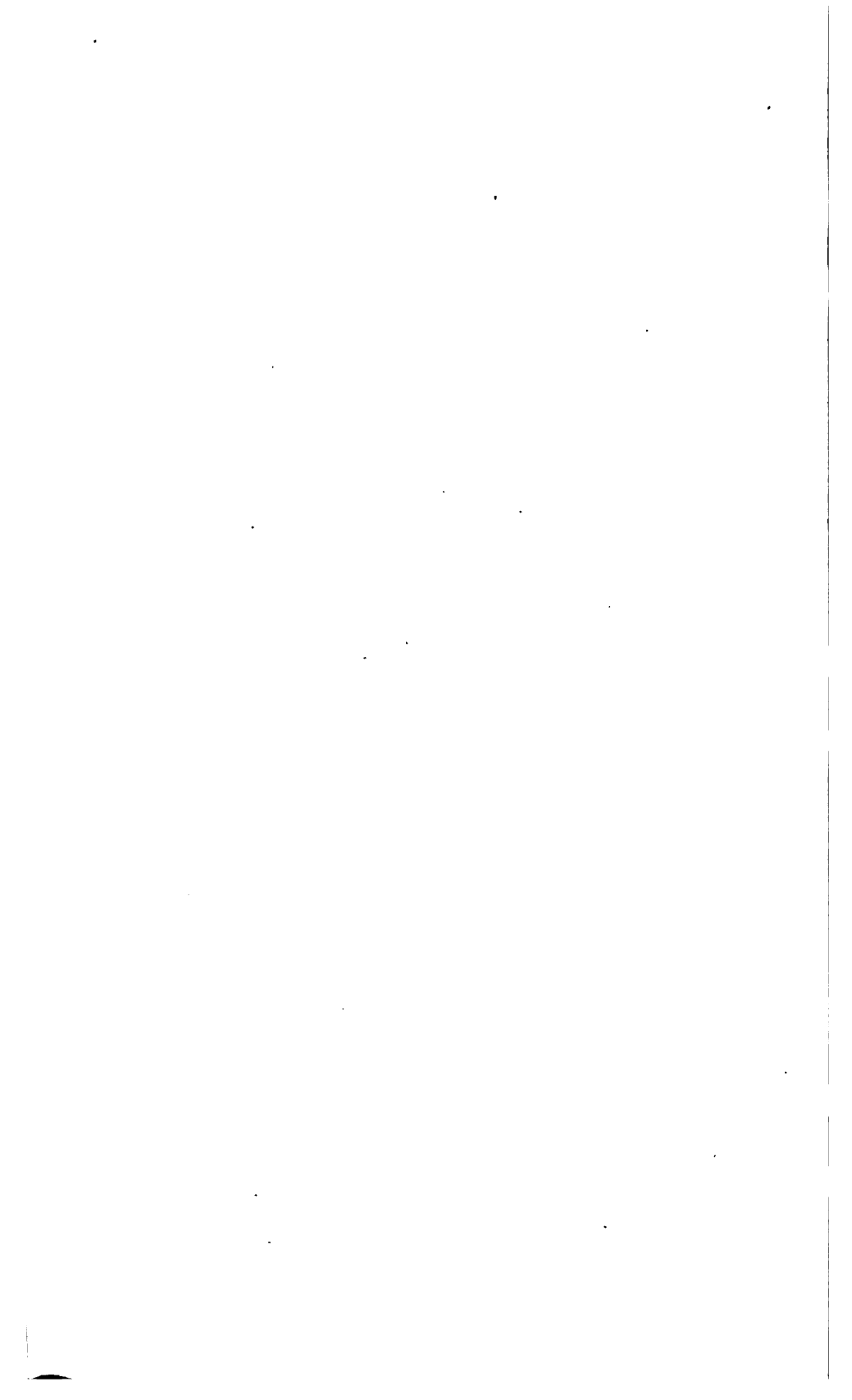
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New York State Museum

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NOV 22 1904

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Published monthly by the

University of the State of New York

BULLETIN 314

JUNE 1904

11,983

New York State Museum

Bulletin 63

PALEONTOLOGY 7

STRATIGRAPHIC AND PALEONTOLOGIC MAP

OF

CANANDAIGUA AND NAPLES QUADRANGLES

BY

JOHN M. CLARKE

State Paleontologist

and

D. DANA LUTHER

Field assistant

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Bulletin 63

PALEONTOLOGY 7

STRATIGRAPHIC AND PALEONTOLOGIC MAP OF CANANDAIGUA AND NAPLES QUADRANGLES

INTRODUCTION

The region covered by these maps is a classical one in the history of New York paleontology. In the days of the original survey of the old fourth district, 1836 to 1843, Prof. James Hall, the district geologist, frequently made headquarters on the beautiful shores of Canandaigua lake and both then and in later years the richly fossiliferous shale beds exposed along the lake shore and in its ravines, afforded to him inexhaustible resources for collecting their organic remains. As representative of the strata embraced within the "Hamilton group" no series of exposures in the State has been so thoroughly exploited as these. Canandaigua and its lake, 70 years ago, were easily accessible and so were the numerous villages scattered through northern Ontario county, but about the latter the rock exposures have always been few and hard to find because of the great thickness of the drift mantle. Southern Ontario was more remote and though the township of Naples was reached by Hall it was for a brief visit only, and its splendid exposures and interesting faunas were left for subsequent researches.

Canandaigua was the writer's home town and Naples the home of his pioneer ancestors in western New York. During the early years of youthful enthusiasm for geologic study the rocks of Canandaigua and vicinity were the subject of prolonged and careful analysis. In the days from 1870 to 1880 the entire fauna was studied in such detail that the vertical range of every known species, and many before unknown, of the Hamilton stage was established and from other formations large accretions to known facts were made. So productive were the investigations of this period in increasing our knowledge of these faunas that in the "Monograph of the North American Devonian Crustacea," published at a later date as volume 7 of the *Paleontology of New York* nearly 200 figures were given of trilobites and other crustaceans collected by the writer during this time and in this region.

The Portage strata of the township of Naples, as a result of careful researches begun then and continued till the present, opened up a virtually new fauna in the New York series. The study of the Portage fauna, desultory at first, began seriously only when in companionship with Mr D. Dana Luther, it was attacked with unremitting assiduity and in this companionship the exploitation of this fauna has been carried forward throughout the entire extent of this formation in the State. For 20 years no circumstances were permitted to interfere with the yearly joint attack on this problem, and though this long standing companionship in the field has been latterly interrupted by force of circumstance, Mr Luther has diligently carried on the refined stratigraphic study of the Naples rocks and their equivalents while the writer has been more specially concerned in the solution of the paleontologic and bionomic problems to which the faunas have given rise.

In 1885¹ the writer published a geologic map of Ontario county. Up to that time the rock formations of the region had not been delineated in greater detail than given on the old

¹N. Y. State Geol. 4th An. Rep't.

state map of 1843. This map, which was the summation of some years of observation, served a useful purpose and has been the basis of the maps herewith presented. Accompanying the map of 1885 was a brief account of the variations of the faunas according to the formations represented. Our present data enable and require us to analyze in closer detail variations in sedimentation sometimes accompanied and sometimes unaccompanied by variations in faunation. It was made clearly apparent by the writer's long study of the changes in the fauna of the Hamilton shales and limestones that very few variations of material importance in the composition of the fauna throughout the entire series of these deposits were tangible and this same condition has been shown to prevail in the deposits of this period wherever the sediments maintain the singularly homogeneous character shown in this section.¹

We have introduced a considerable diversity of coloration on these map sheets but such refined distinctions in sedimentation are now essential to the complete understanding of bionomic conditions and stratigraphic changes during the period of deposition of these strata. They are essential also as an aid to the correlation of the rock section here given to that in adjoining regions of the State. Many of the names may prove to serve only a local, perhaps some of them only a temporary, purpose. Certain of the divisions have however a higher value and indicate periods of uniform deposition over wide areas in western and central New York. An apology or excuse for the refinement of these stratigraphic subdivisions is not necessary. The multiplication of local names as formation terms is one of the imperative accompaniments of progress in the interpretation of ancient marine conditions.

¹The attempt thus made many years ago to determine a basis of subdivision in these homogeneous sediments on the basis of the range of the fossils, proved as inconsequent as similar efforts subsequently made in this series of sediments. Were one concerned to construct a doll's philosophy from imaginary laws conceived to govern the association of species into faunules the extraordinary uniformity of faunation in these beds should afford an oppugnant problem.

FORMATIONS

The rock formations here represented as units of sedimentation may be grouped in broader divisions in the manner following:

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SILURIC

General observations. All these formations are so deeply buried under a continuous drift mantle that their variations can be studied only at a disadvantage. We have indicated the contact lines of these as well as the lower Devonian formations as appended, by slightly undulating lines traversing the region in a nearly east and west direction. It is our belief that such lines bound the palpable outcrops over a region which before becoming enveloped in the drift was not deeply channeled and by the rigidity of its rocks was able to resist the erosion which further south has broken up the softer formations into projections and outliers.

Camillus shale

The lowest formation in the rock series and northernmost on the Canandaigua sheet is that subdivision of the Salina group of formations which consists of soft gypseous shale or plaster rock,

dark when fresh but becoming light ashen gray on exposure. These beds are both underlain and overlain by thin light gray magnesian limestones or platten dolomites. Entire thickness 50 feet.

On account of the meagerness of the exposures throughout the northern area of the Canandaigua quadrangle the exact position of the contact line between the red or Vernon shales and the gypseous Camillus shales, which is the equivalent of the rock beds of western New York, is not apparent. The lowest rock exposures are along Mud creek below Brownsville and in the bed of Ganargua creek just to the north of the north line of the sheet. Here are two outcrops, one just above and the other about 25 rods below the bridge, which show a few feet of very fine hard dark bluish drab limestones characterized by needle cavities or stylolites, which mark the magnesian limestones of the gypseous deposits of the Salina group elsewhere. These layers are easily broken into small and regularly shaped blocks. Between the dolomites are thin layers of bluish clay shales. In the Goose Egg, an oval hill 1 mile south of Brownsville on the west side of Ganargua creek there occurs the most northerly outcrop of the upper gypsum or plaster bed. The exposure is a small and isolated one and is obscured by drift and disintegrated shale. Gypsum was formerly quarried here. One mile farther south the gypsum outcrops at the foot of the declivity on the west side of the Ganargua creek channel and "land plaster" has been quarried here for many years and ground in Conover's mill near by. In consequence of the expense attending the stripping of the heavy covering of drift, 30 to 40 feet thick, the small amount of plaster produced in recent years has been mined, access to the bed being had through a horizontal tunnel at the base of the hill. The breast of the mine is 14 feet high. The gypsum is purest at the bottom. This bed is a continuation of the one from which "Onondaga land plaster" is obtained in Onondaga county; "Cayuga plaster" in the vicinity of Union Springs, Cayuga co., and "Vienna plaster" along the Canandaigua outlet in the western part of the town of Phelps. It is 30 to 40 feet thick in this region and is composed

of the hydrous sulfate principally in the impure condition and not infrequently appears crystallized as selenite and in flaky condition mixed with very soft dark bluish clayey shale. Where the gypsum predominates the rock has a distinctly crystalline appearance but where the proportion of shale is greatest the lines of sedimentation are very apparent and it has every resemblance to ordinary soft dark shale. Joints occur everywhere throughout the rock beds and through these the percolating waters have had access to the gypsum deposits and have frequently removed them, thereby causing a settling of the shale material adjacent and leaving hemispheric masses between the resultant depressions. Doubtless the present hummocky condition of the beds, not alone in this region but throughout the area of surface exposure of Camillus shales is largely due to causes connected with the change from anhydrite to the hydrous sulphate or gypsum. There are a few thin even layers of hard magnesian limestone interstratified with the gypsum and at the top of the bed there are 8 to 10 feet of soft blocky shales containing but very little gypsum. This latter bed is exposed at the east end of the Lehigh Valley Railroad cut 1 mile east of the village of Victor, and also in the bed of Mud creek near the Lehigh Valley Railroad bridge and at Fredon or East Victor. The more productive development of the gypsum industry in this region however is in the territory just east of the quadrangle in the town of Phelps, where for more than 70 years it has been produced on a large scale, though the production has now notably fallen away.

Bertie waterlime

This term, derived from Bertie township in western Ontario, is specially characterized by the abundant presence of the crustaceans *Eurypterus*, *Pterygotus* and *Ceratiocaris*. It consists chiefly, in the Canandaigua region, of hard dark impure hydraulic limestone in thick layers separated by thin seams of dark and apparently carbonaceous matter. The rock weathers to a light brown or buff. Thickness 40 feet.

The passage from the Camillus shales into these beds now termed Bertie waterlime is a very gradual one, the loss of gypsum being

replaced by the addition of alumina and carbonate of magnesia, so that the succeeding stratification becomes highly dolomitic. The distinguishing mark of the division as already noted, is the presence of merostome and phyllocarid crustaceans, which attained at this time their culmination of development.

Along the creek for 10 rods below the bridge at East Victor are from 30 to 40 feet of hard compact dolomites with distinct lines of sedimentation, having a characteristic clink and conchoidal fracture. The dark blue of the rock changes rapidly on exposure to a light, dark or ashen gray. The same horizon appears in the Lehigh Valley Railroad cut 1 mile east of Victor, though the exposure here is for only about 6 feet at the bottom, just over the Camillus shales. Eastward also in the adjoining quadrangle occasional exposures are seen. Remains of the crustaceans referred to are by no means as common here as at the well known localities to the west at Buffalo and to the east in Herkimer county but the horizon is doubtless the same, and segments, heads and appendages of these creatures are not uncommon. With them is frequently found a *Leperditia*, probably *L. alta* Conrad and the brachiopods *Whitfieldella laevis* Vanuxem and *Leptostrophia varistriata* Conrad.

Cobleskill shale and dolomite

This is a rather obscure representative of a formation which has recently been shown by the investigations of Hartnagel to extend without interruption from eastern New York to Buffalo and beyond. It is regarded as deposited soon after the close of the period of the Salina and it here consists of dark, hard shale and straticulate, impure limestone, succeeded by a thick bed of massive dolomite, the top of the formation consisting of platten dolomites. The thickness ascribed to these beds is approximately 42 feet, of which 18 feet are assigned to the shale, 20 feet to the heavy dolomite and 4 feet to the platten dolomite on top.

The section at East Victor exposes the massive beds of this horizon, immediately below the topmost layers constituting platten dolomite. In the high bluff on the east bank of the creek

in the rear of A. B. Cooper's residence there are beds of dolomite which, aggregating 8 feet in thickness at the base, are succeeded by 15 feet of dark bluish shale and these are overlain by 6 feet of dolomite like that below. Overlying these layers and exposed for many rods in the bed of the creek is a mass of tough argillaceous limestone 15 feet thick that bears *Stromatopora* quite abundantly and seems to indicate a western continuation of the well known *Stromatopora* bed at this horizon in Onondaga county. It is dark brownish gray when freshly broken and usually takes on a darker tinge of brown for a time owing to the exudation of a minute quantity of petroleum but finally turns to a light yellowish drab. It contains many small aggregations of selenite crystals, and the boulders from it by reason of their peculiarly tough character have survived glacial transportation and grinding and are strung in great numbers over the contiguous territory to the south, have many small cavities and a general scraggy appearance due to the weathering out of these crystals.

A bed of shaly dolomite 4 feet thick is the highest member of the group. This appears in the west bank of the creek a short distance below a low fold 60 rods north of the New York Central Railroad bridge at Mertensia. There are several small exposures of these upper beds in this vicinity, the most extensive of which is in the section afforded in the Hog hollow or Great brook ravine on the west side of Boughton hill, where 25 feet of the top layers are well displayed. The two upper members appear $\frac{1}{2}$ mile east of Fredon and have been quarried on the land of A. B. Cooper and Hiram Powell, and at the latter place there are the ruins of two limekilns where material from the *Stromatopora* layer was formerly burned and then hauled to Conover's mill and ground for cement; there are several other abandoned kilns in the vicinity in which quicklime was once produced from the purer layers below. No other exposures of these beds have been observed in this western portion of Ontario county, but they are of more frequent occurrence eastward, just beyond the line of the quadrangle and are there more freely worked and contain organic remains in greater

number. The fossils occurring here, besides the *Stromatopora*, are *Leperditia alta* Conrad and *L. scalaris* Jones, *Cyathophyllum hydraulicum* Simpson, *Spirifer eriensis* Grabau and *Whitfieldella sulcata* Vanuxem. Fragments of *Eurypterus* also occur at this horizon.

DEVONIC

General observations. The division line between the great Siluric and Devonic systems is very well marked here on account of the entire absence of the Helderbergian limestones, which, in the eastern part of the State, represent the incipient stages of Devonic deposition. There is good reason to believe that the uppermost Siluric beds which we have just considered were for a time exposed above water to the action of aerial decomposition and erosion before the later sediments were laid down on them. This has been found to be the case in Erie county, where the eroded upper surface of the Cobleskill dolomite is overlain by a regular deposition of the following formations.

Oriskany sandstone

In eastern New York this formation takes on, in certain places, the character of an arenaceous limestone but it is an interrupted deposit in its course across the State from east to west, though in places tremendously abounding in fossils. At Oriskany Falls and at Union Springs it assumes the character of a more or less friable whitish sandstone. The formation constantly thickens and thins, forming lenses, as in Cayuga county, sometimes 20 or more feet thick and then again thinning to actual disappearance. As it becomes thin it usually assumes the character of a hard compact quartzite composed of silicious grains cemented by a deposit of silica. Throughout western New York this thin bed frequently contains angular masses, evidently washed from the hydraulic limestone beneath and thus forms a breccia. In Ontario county the exposures of this rock are largely confined to the township of Phelps a few miles to the east of this quadrangle. From its uneven thickness and general appearance at this place and the fact that it fails entirely within a half mile on the east and a

mile on the west it would indicate here as elsewhere, that it was a deposit of a sand bar running out from the irregular coast line of the time. This deposit in the town of Phelps is the last of the lentils which the formation assumes in western New York. It is 6 feet, 6 inches thick and consists of several distinct layers. In the upper part of the top layer there are many elongate rounded pebbles and cobbles of black quartzite embedded in the light sandstone and the rest of the deposit is largely of coarse sand with a lumpy or slightly concretionary structure. In these outcrops the only evidence of fossils is the presence of a few obscure corals. On Mud creek 50 rods below the railroad bridge at Mertensia, there is an exposure of the same material but more quartzitic, containing the waterlime pebbles, the layer being 6 to 8 inches thick. In Phelps the sandstone was at one time quarried for firestone for use in the glass furnaces at Clyde.

Onondaga limestone

In general character this important deposit is a compact, dark bluish gray limestone frequently carrying interbedded layers of chert nodules, the limestone itself being bedded in layers from 6 inches to 3 feet in thickness. It contains a large amount of carbonaceous matter, which appears on the surface of the layers and in the shale partings between them and discolors most of the strata, frequently giving them a decidedly black appearance. It is removed by gradual decomposition on exposure and the rock slowly assumes a very light bluish gray color. The chert or hornstone is usually nearly black and slightly translucent, but sometimes lighter colored and bluish. It is very unevenly distributed in the beds in some of which it predominates and in others is entirely absent. The nodular layers in which it lies are frequently continuous for long distances and owing to their resistance to decomposing agencies, old exposures of the beds and the innumerable boulders and fragments from them strewn over the region south of the escarpment formed by this formation, have a peculiarly ragged and scraggy appearance. At some of the outcrops one or more of the layers are shaly but only a small proportion of the formation is of this character and all of the remainder, wherever

the amount of chert is not too large, is compact and durable and exceedingly valuable as building stone and for the production of quicklime. If the chert is entirely absent the limestone is easily quarried and makes very handsome dark gray cut stone building material, and the cherty masses have been extensively worked for bridge abutments, canal locks, retaining walls and kindred purposes.

This formation covers a belt 1 to 3 miles wide across the towns of Mendon, Victor and Farmington and some exposures of the uppermost beds occur also in Canandaigua. The more striking outcrops of the rock and those which have long been most available for exploitation are in the region just to the east, specially in the towns of Manchester and Phelps. In a general way it may be stated that at the base of the formation there are from 3 to 5 feet of limestone, very rich in corals and without any chert. The rest of the formation which attains a total thickness of about 120 feet has both chert and shaly layers scattered through the limestones at irregular intervals.

In Farmington the lower beds crop out on the north side of the road leading from Manchester to Victor and have been extensively quarried, the stone used in the construction of the Erie canal locks at Macedon having been obtained from this locality.

In the bed of Mud creek the base of the formation appears about 60 rods below the railroad bridge at Mertensia, in a low anticline, the axis of which crosses the stream diagonally. Here it rests on the Oriskany sandstone and the lower 5 feet are free of chert and are crowded with corals, the stratum being identical in character and appearance with the basal layer farther east. These layers are capped by a series of chert-bearing beds, together aggregating 5 feet in thickness. Above the bridge there is an extensive picturesque cascade and an exposure of 40 to 50 feet of the middle and upper beds, the outcrops extending though not continuously, 100 rods south of the cascade. The rock at this place has been worked for construction stone.

In the section along Great brook or Hog hollow at Victor the lower layers appear overlying the Oriskany and at this point the

rock was formerly quarried both for building stone and for burning. In the ledges of the creek above the quarry are some of the higher cherty layers.

For the most part however the formation is buried under the drift and from this point to the western limit of the sheet no other outcrop has been found.

The higher layers of the limestone, lying with glaciated surface beneath the soil cap, are seen in the old Giddings quarry, now known as the Bacon quarry just to the east of the edge of the map.

In general it may be said that this formation forms the most important repository of valuable building material within the region covered by the map, and furthermore in the harder chert layers is a convenient and inexhaustible source of road material not inferior in quality to the field stone that has been generally utilized in the county in recently constructed roads.

Marcellus shale

The term Marcellus shale has been generally applied in New York geology to a black and dark blue shale formation lying immediately on the Onondaga limestone. The lower boundary of the formation is always perfectly clear but not so with the upper, for the mass passes gradually into the lighter gray shales of the Hamilton group above. At Marcellus village, Onondaga co., from which place the name is derived, only the lower layers of this black shale are well exposed and our observations both in that region and thence westward indicate the desirability of restricting the term Marcellus to these lower shales, which are typically exemplified in the original locality but are better delimited upward in Ontario county by the presence here of a limestone cap—the Stafford limestone. Using the term in this restricted sense the Onondaga limestone is overlain everywhere by black slaty shale with a few thin calcareous layers and rows of spheric calcareous concretions. The shales are highly impervious and argillaceous and withstand exposure so well that their outcrops are usually vertical or overhanging cliffs in a

region where there has been but little deep stream-cutting. Owing to their rigidity they are highly jointed and rhomboidal, triangular and diamond-shaped slabs being characteristic of all surface exposures. It is difficult to estimate the thickness of this bed but it appears, from comparison of outcrops here with the total thickness afforded by the Livonia salt shaft section where it was 43 feet with a slight tendency to increase eastward, to be about 50 feet. The actual contact of these beds with the underlying Onondaga limestone has not been observed, but the lowest outcrop of the formation on this quadrangle appears on the west side of the fill on the New York Central Railroad, just north of the cut near Padelford. The higher beds are well exposed in this same cut where they are densely black shales with some thin limestone layers. The same beds appear along Mud creek about a mile south of Mertensia.

The distinctive character of this shale as an initial part of the beds which have heretofore generally been assigned to the Marcellus stage, is its uniformly bituminous nature and consequent dark color and its very small proportion of lime content except in the thin calcareous beds themselves.

Stafford limestone

The group of strata which have customarily been incorporated within the general term Marcellus shale embraced an interesting limestone layer, the presence of which was early noted by Professor Hall and which was termed by the writer some years ago *Stafford limestone*, on account of its high development at Stafford in Genesee county. This is a dark chocolate and somewhat nodular limestone, very hard when fresh but breaking easily into angular fragments on exposure. We have shown in various publications that this formation extends eastward with a diminishing thickness and we know that its last surface appearance is along Flint creek in the southwestern part of the town of Phelps, Ontario co. Though not exposed to the eastward it is evident that the formation in slight thickness (it has a thickness of about 8 inches in Phelps) occurs as a thinning wedge through this area,

for the very characteristic blocks of this rock are quite freely scattered south of the line of outcrop and specially in the east bank of Mud creek. Two miles south of Mertensia the blocks are so common and in such a condition as to indicate very slight removal from place.

Cardiff shale

The upper beds, heretofore generally included in the old term Marcellus and termed by Vanuxem the "Upper shales of Marcellus" are finely shown in and about the village of Cardiff, Onondaga co. As we have restricted the former term, it seems best to adopt for the succeeding layers a name derived from these excellent exposures near the typical region, as in Ontario county they are nowhere seen to so good advantage.

The Stafford limestone is overlain by a series of dark calcareous and black slaty shales with thin layers of fossiliferous limestone. Both limestone and shales weather to a light ashen gray on long exposure. So far as the fossil contents are concerned they are not essentially unlike those of the darker shales below but the gray aspect of the beds and their much higher calcareous content indicate a distinctive difference, which is readily marked throughout this region. Outcrops of these layers are again very few. The best of them is in the bed and sides of Mud creek at its confluence with Shaffer creek in the north-eastern corner of the town of East Bloomfield. They are also exposed in the upper part of the railroad cut section just south of Padelford station. Directly over the line of the quadrangle to the east is an exposure on the east bank of the Canandaigua outlet below Chapinville, and here some of the harder layers were at one time quarried for flagstone and used in the village of Canandaigua but they proved to check very rapidly under exposure and wear. For a quarter of a mile this exposure is continued in the bank of the outlet. At no exposure is the entire thickness of this bed revealed. The heaviest mass of material shown at any one place is in the section on Flint creek just south of Phelps, Ontario co., where there lie on top of the Stafford limestone about 50 feet of these shales, the cal-

careous material increasing toward the top though the dark shales predominate throughout. The gradual increment of lime content makes the passage from this bed into that following essentially imperceptible, but there are accompanying notable distinctions in the composition of the fauna. Taking into account a proper allowance for dip it is estimated that the thickness of the Cardiff shales is here about 100 feet.

Skaneateles shale

This term was applied by Vanuxem to the beds immediately overlying the upper Marcellus, and exposed on both sides of Skaneateles lake at the north end. They are evidently continuous into the Canandaigua area without essential contraction or change and hence the early term is now employed for them rather than the designation Shaffer shale incidentally used in a recent tabulation of these formations. With the increase in calcareous matter the shales become hard, blue black, in places quite black, passing into light and softer beds above with layers of soft impure limestone. For a thickness of 125 feet this shale bed keeps its distinctive characters across the Canandaigua sheet though the distinction is based on comparatively few exposures. These deposits are exposed in the bed of Mud creek south of the highway bridge near the junction of Shaffer creek, $\frac{1}{2}$ mile north of Wheeler and also along Shaffer creek at $\frac{1}{2}$ to $\frac{3}{4}$ mile south of Wheeler. A slight exposure of the black shales is also shown in a small drainage section just below the Robertson quarry adjoining the New York Central Railroad on Fort hill in the eastern part of the village of Canandaigua. They are shown in nearly full strength in Miles gully in the town of Hopewell, just east of the east line of the quadrangle.

Canandaigua shale

Including the Centerfield limestone at the base

Two terms which have become ingrained by long usage in the nomenclature are the *Hamilton group* and the *Ludlowville shales*. The former, introduced by Vanuxem in 1840, was at no time em-

ployed by the original state geologists in any other form and it is evident that the significance here of the term *group* is its reference to the variability of the strata in the typical Madison county sections where they are sandstones, arenaceous and argillaceous shales, not a composition of defined lithologic units. In other words the term is used with the same breadth of meaning as other unit terms of the series and not as the word was subsequently employed in the final reports of the geologists nor in the widely different sense made use of by Dana and generally current. The division was clearly defined and its place in the series is precisely that ascribed to the Ludlowville shales in the Cayuga lake section as was defined by Hall in 1839. Ludlowville was not altogether well chosen as exemplifying the latter division, for the Tully limestone is present in the village and the Moscow shales beneath; one must go afield to find the true Ludlowville strata, but it is evident that Professor Hall's conviction at that early day that these were the representatives of the Ludlow shales of England, influenced his choice of name. We would reject neither name in favor of the other. Each expresses essentially the same interval but a differing series of sediments and some marked distinction in fauna. Each will be found to have a definite meridional value. Hence further west and in the area here under consideration we find still other differences expressed in this interval both lithologic and faunal and are constrained to express these by the terms employed above.

The Canandaigua shale is constituted of soft, dark bluish and gray calcareous shales with impure limestone beds at the bottom, and irregularly nodular calcareous beds abounding in corals toward the middle of the formation. This is a highly fossiliferous mass and its distinction from the beds beneath lies not alone in the nature of its lithologic character, but essentially in the abrupt manifestation of the highly profuse and typical Hamilton fauna. The Skaneateles and Cardiff shales have been regarded as a kind of transition deposit from the typical bituminous Marcellus shales indicating the gradual approach and encroachment of normal Hamilton

conditions together with the advance of the Hamilton fauna. The estimated thickness of the Canandaigua shale is about 125 feet. It is excellently exposed along Shaffer creek immediately south of the exposure referred to above and about a mile north of the village of Centerfield. At this locality the lower calcareous layers and the shale overlain by the coral beds are admirably exposed and have been a most prolific source of fine fossils. These beds also appear within the village of Canandaigua, there being exposures of the impure calcareous beds on east Gibson street at the now abandoned Maggs quarry and also in the more recently opened quarry on the Robertson property south of the Chapinville road. Here the beds, when fresh, are a fairly compact limestone but their schistose character soon checks them on exposure, and they have never proved a satisfactory construction stone. They are however enormously prolific in corals and represent the coral reef better exposed on Shaffer creek. It is probable that beneath them lie the shaly beds, but the limestones which lie near the bottom on Shaffer creek and which are of more compact character, though somewhat more argillaceous in composition, may prove to be absent here. Below the Robertson quarry, to the New York Central Railroad tracks, is a small drainage way which gives indications of the underlying beds down to the blue black Skaneateles shale. The exposure however is not sufficiently clear to demonstrate the presence of the limestone beds referred to. If they are here they would serve as a more substantial building stone for rough purposes such as foundations and cellar walls, than the stone above, that is now or has been worked for this purpose. These lower limestones, which are specially characterized by their fossil contents and have produced some species which have not been found elsewhere, have been designated in a subsidiary sense as the Centerfield limestone.

The upper beds of the Canandaigua shale outcrop on the east shore of Canandaigua lake at Cottage City and in the ravine of Gage's creek and Deep run. On the west side of the lake the shale beds are well shown in the cliffs between Tichenor and Men-

teth points below the Tichenor limestone, and from Tichenor point northward there are several small outcrops along the side hill as far as Hope point and over the region to the westward; lying just at the lower declivity of the rise of land the rock appears where the drift mantle is thin.

This mass of sediments is probably equivalent in part to the *Ludlowville shales* of Hall, but at Ludlowville a limestone called by Hall the *Encrinal limestone* was taken as a line of division between the shale masses, the upper being called the Moscow and the lower the Ludlowville. It is yet to be determined whether that Encrinal limestone is continuous with the Encrinal or Tichenor limestone of the section under consideration and for the present we can not employ here the name Ludlowville with entire security. Hence the term Canandaigua shale is employed on behalf of more accurate, though perhaps provisional expression.

Tichenor limestone

This name is applied to a compact layer of hard bluish gray often crinoidal limestone which has a thickness of about 1 foot. It is separately designated for the reason that it is a continuous formation across this area and well to the east and west beyond it. It contains some of the characteristic fossils of the rock but they are not specially abundant and are frequently replaced by depositions of strontianite. This rock has been commonly known as the Encrinal limestone, a name applied to it by Hall as long ago as 1839 and has been used by many writers in application to limestone layers lying at actually distinct horizons in these rocks, specially from the meridian here under consideration to Lake Erie. On comparison of this section with that on Cayuga lake where the Ludlowville shales were originally defined and the typical exposure of the Encrinal limestone was located, it was found that there is no concurrence in the horizons indicated there and here by the same term. In view of the various limestone strata that have been referred to under this name and its extraordinarily frequent employment throughout all geologic formations with a great variety of stratigraphic meanings, it is best to abandon the

term altogether. At Tichenor point the limestone is exposed along the roadside at the opening of the ravine and it reappears on the shore of the lake just south of Tichenor point where it forms a low but well marked anticline cut off at one end by a slight displacement. Here it dips under the water and reappears at the north side of Menteth point forming a broad platform at the water level.

These are the best outcrops of the formation known in Ontario county and the rock also appears slightly in the lower part of the Miles gully in Hopewell and on Flint creek south of Castleton. A limestone of similar character is exposed in the bed of Beebe brook, West Bloomfield, but it is not altogether certain that it belongs to this horizon.

Moscow shale

The Tichenor limestone is overlain by a mass of mostly soft, light bluish gray calcareous shales, becoming darker toward the upper part. Thin layers of limestone usually extending but a few rods and irregular calcareous lenses largely composed of fossils are of frequent occurrence. At the base of the mass lying immediately on the Tichenor limestone the shale is very compact and highly calcareous and breaks out in irregular slabs. This portion of the deposit is very persistent over a wide area and is characterized by the abundance of crinoids which it contains in the most admirable preservation. Indeed this is the horizon which has furnished all the superior crinoid material from these rocks in this part of the State. It is this layer, which with the Tichenor limestone has in previous reports, specially the description of the geology of Ontario county published by the writer, been designated as the Encrinal band. An exposure of this layer on the farm of Mr Sisson, not far from the village of Muttonville, now Vincent, in the northern part of the town of Bristol, afforded to the collectors of the State Museum in 1860, C. A. White and C. Van Deloo, an immense amount of fine material, constituting the best preserved and most complete series of crinoid calyxes ever obtained from the rocks of this State. This exposure is

no longer accessible and appears to have been overgrown by vegetation with the drying up of the brook. Seventy-five feet above the Tichenor limestone is another limestone layer lying in the midst of this shale mass. This is here designated as the

Menteth limestone, and is worthy of special remark for several reasons. It is a well defined bench mark in these Moscow shales entirely across the map. As a rock it is a compact layer about a foot in thickness and usually very pure but in places it proves to be quite argillaceous and nodular. It is a notable repository of the fossils of the fauna and these are very frequently replaced by silica with a degree of delicacy and perfection seldom equaled; perhaps not elsewhere in the paleozoic rocks of the State nor in rocks of ancient date from any locality known to the writer is this replacement so satisfactory to the student of the biologic problems of paleontology. The etching of the purer part of this layer has afforded a most beautiful series of the species of the fauna and as these are retained not alone in adult condition but from the earliest shell-bearing stage on, the material has already been the subject-matter of several important treatises on phylogeny, ontogeny and the systematics of different groups of organisms. We may refer to the papers of Beecher on the trilobites and on certain of the corals, to Grabau's investigation of the corals, to the writer's publications on some of the brachiopods, etc. An indication of the delicacy of these replacements is afforded by some of the shells of the brachiopod *Productella* in which the hairlike spines on the body of the shell projecting for a length greater than the diameter of the shell itself, are preserved without defect. This Menteth limestone forms the first falls in the ravine at Tichenor point and also in that at Menteth point. It and the shales beneath are well exposed in these places and the shales themselves specially along the shore of the lake between the two points. On the opposite or east side of the lake both shales and limestone are found in Gage creek and Deep run, and again on the east side from Menteth point southward to Foster point. Farther north is an exposure of the limestone and some of the underlying shales at Hope point ravine.

The upper part of the Moscow shales is exposed on the east side of the lake in the Gage creek ravine where, about 50 feet above the Menteth limestone, a series of nodular layers of limestone 2 feet thick form a low cascade. Also in the ravines of Bennett's landing, Gooding landing, Long point and along the lake road and shore to the Gorham-Middlesex town line. The same series is displayed on the west side of the lake from $\frac{1}{2}$ mile south of Black point northward to Foster point, and in the upper parts of the Menteth, Tichenor and Hope point gullies. They are shown in the bed of Shaffer creek $\frac{1}{2}$ mile north of the Gooding schoolhouse near the western boundary of Canandaigua township and also in the Bristol valley in several small ravines on the east side between South Bloomfield and Vincent, and in the lower part of the ravine on the east side of Baptist hill.

Tully limestone

Ontario county includes the westernmost and final appearance of this important, though relatively thin, rock formation. In the towns of Geneva and Seneca to the east and also in Gorham, except close on the shore of the lake, this limestone appears with constantly diminishing thickness, and its last appearance is in Gage creek about 40 rods east of the eastern boundary of the map. Here it is a bed of dark bluish gray, hard, brittle limestone and at its last exposure attains a thickness of 2 feet and 8 inches. Doubtless the stratum extends a mile or more beyond this point to the southwest, as some loose blocks 8 inches thick, apparently but slightly displaced, lie in the bottom of the small gully at the side of the road leading eastward up the hill from Bennett's landing. Eastward of this region and throughout central New York as far as Chenango county the Tully limestone is prominently developed and attains at its maximum a thickness of from 20 to 30 feet. On the Canandaigua sheet at all other exposures except those mentioned, the Moscow shales beneath and the Gorham shales above are in contact or separated by lenticular discontinuous layers of iron pyrites from 10 to 50 feet on the edge and 1 to 4 inches in thickness, the material of which is very hard and in damp places is

not affected by exposure but in cliff faces is usually disintegrated. This singular deposit is exposed in the ravines on the east side of the lake from Gooding landing southward to Fishers and in the shore cliffs to the Gorham-Middlesex boundary. On the west side from just south of Black point along the shore and northward in ravines at Grange landing, Victoria glen, Foster point and Men-teth point; also following the Moscow shales in the localities in the Bristol valley already cited. This layer of iron pyrites is continuous from this region westward to Lake Erie and indicates with striking persistence the horizon of the Tully limestone as a plane of division between the Hamilton group of formations beneath and the Genesee above.

The Tully limestone itself as exposed in Ontario county localities to the east is a very dark bluish gray rock weathering at first to lighter shades of blue and after long exposure to an ashen gray.

It is in two or three layers that are very hard and apparently compact when freshly quarried. On exposure the rock checks along irregular seams and develops a tendency to split into irregular angular fragments an inch or two in diameter. It has been used for construction stone and at one time was burned for quicklime near the village of Gorham. On Fish creek $1\frac{1}{2}$ miles directly east of Reed Corners, where the highway crosses a small brook, is an exposure showing 4 feet and 2 inches of the limestone, and this exposure seems to have been noted in the report by Professor Hall on the geology of this region in 1843, then regarded as the most westerly appearance of the rock. A more extensive exposure is shown however on lot 53, 1 mile southwest of Reed Corners where the north and south "middle road" crosses a small brook flowing west into Canandaigua lake from a ravine about 40 feet deep and 50 rods long above the highway. Here the limestone forms a floor in the ravine for 2 rods and produces a cascade 8 feet high. The exposure continues for 10 to 12 rods on both sides of the gully and at the cascade the total thickness is 5 feet, 10 inches. Still another outcrop is found 2 miles south of the latter on the lake road from Rushville to Canandaigua near the residence of Mr Merritt Cole. This is the outcrop referred to as being near the

eastern limit of this map and here the exposure shows not only the black Gorham shales above but the soft Moscow shales beneath. It is separated by a thin shaly seam into two layers, and in the lower layer iron pyrites is highly abundant in nodules, probably representing the commencement of the pyrites layer, which from here westward is the sole representative of this formation. The place of the Tully where the limestone is wanting and the pyrite layer not clearly apparent is always well defined by the sharp line of contrast between the gray Moscow shales beneath and the overlying black Gorham shales.

The Tully limestone, as has been recognized since the observations by Conrad in 1836-37, is distinguished by the presence of the species *Rhynchonella* or *Hypothyris cuboides* and the equivalency of this geologic horizon with the *Cuboides* zone of Europe has been a fact of general recognition for more than half a century. This fossil is very abundant in the outcrops in Ontario county but the rest of the fauna is essentially that of the underlying beds of the Hamilton group, specially the Moscow shale. We shall presently note in more detail that the fossils contained in the pyrite layer have all been singularly dwarfed by the unfavorable conditions of growth and are regarded as representing stages of arrested development of Hamilton species, the characteristic *Hypothyris cuboides* not having been found therein.

Genesee shale

This term was originally applied by Hall to a division on the Genesee river section consisting of very dark bituminous beds at the base becoming lighter colored and more sandy upward. The highly bituminous beds are distinctly defined by their character and their definition at the top by the Genundewa limestone. It was clearly this excessively black mass of shale that it was intended to distinguish by the name Genesee and as it is now important to refine the subdivision of this series of sediments for more exact correlation, it is here proposed to restrict the term Genesee to this lower member only.

Directly over the Tully limestone, or its horizon when absent, lies a mass of densely black bituminous shale becoming very

fissile on exposure and splitting into large flat plates. Owing to their rigidity these shales are traversed by parallel series of joints intersecting each other at different angles and producing in cliff exposures striking masonry effects like buttresses and bastions and on the surface of horizontal exposure equally striking tessellations, triangles, rhomboids, diamonds and kindred forms. Intermingled with these beds are well defined horizontal rows of calcareous concretions. Occasionally a thin plate of limestone is shown. The beds also contain iron pyrites in nodules and nodular layers. This mass at once recognized by its structural characters as indicated has a thickness of 95 feet and is terminated by the *Styliola* limestone or as here designated, the Genundewa limestone. All these shales are extremely sparse in fossils, more highly bituminous beds showing remains of plants and Conodont teeth, and where the beds become a little bluer and slightly calcareous are *Lingulas* and *Orbiculoideas* with *Pterochaenia fragilis*.

These strata are finely exposed all through the upper parts of the ravines on the east side of the lake from Gooding landing southward to Fishers and in the shore cliffs to Genundewa which lies at the base of Bare hill as it is termed on the map; on the opposite side of the lake in the shore cliffs from Hicks point northward to Black point, and in the lower part of the ravine at Seneca point and the upper parts of ravines back of Grange landing, Victoria glen and Foster point, and throughout most of the rock section in the Menteth ravine back of the village of Cheshire. In the Bristol valley the upper parts of all the ravines heretofore mentioned from South Bloomfield to Vincent and also at Baptist hill show these rocks. They appear as far north as the upper reaches of Shaffer creek near the western town line of Canandaigua, and west to Baptist hill along the valley of Beebe brook.

Genundewa limestone

A dark gray limestone in layers of from 2 to 10 inches in thickness separated by dark or black shale. Some of the layers are even and flaggy, others are concretionary and nodular. Where purest the limestone is almost wholly composed of the shells of

Styliola (*Styliolina*) *fissurella* and from that fact has taken the name of *Styliola limestone*, by which it has been generally known. The horizon is well marked and divides the mass of Genesee deposits into nearly equal parts in this section. It is a persistent stratum and has been traced to the east as far as Seneca lake and westward to Lake Erie. The character of this rock is well displayed at the typical outcrop on the shore of the lake at the foot of Bare hill or, as it should be termed, Genundewa. Here it consists of three layers of rather soft and slightly shaly limestone, the rock being impregnated throughout with myriads of the shells of *Styliola*; is highly bituminous and hence very dark when fresh. The lowest of these layers is 8 inches thick, the second, 7 feet higher, is 6 inches and the third, 6 feet above, 10 inches, making the total thickness of the entire band including the intervening shales, 15 feet. These layers increase in thickness westward, become less shaly and more nodular, and are eventually consolidated. On account of the durability of this rock it is a permanent feature in all exposures of this horizon and as its peculiar character makes them easily recognizable the Genundewa limestone is important as a stratigraphic bench mark. The rock is of singular interest from a paleontologic point of view as will be noticed hereafter. Its calcareous nature being largely due to fossil remains it has afforded a fauna of considerable scope. We find the best exposures of this limestone in the county in the cliffs north of Hicks point and in the Seneca point ravine where it produces the first cascade, also in the Victoria glen and Foster ravine and on the south branch of the Menteth brook where it produced the high cascade $\frac{3}{4}$ mile south of Cheshire. The point last named is the spot at which the rock was originally located by the writer, though specimens from it had been generally known to students for some time before. It is also displayed admirably at the mouth of the Wilder ravine at Bristol Center and in the ravine on the opposite side of the Bristol valley. In Mill creek or Mill gull in the town of Richmond there is an exposure several rods long in the bed of the stream and the limestones are well developed and highly fossiliferous.

West River shale

Fine, blue black or dark gray shales with thin bands of black slaty shale at intervals of 2 to 6 feet. Spherio or oblong concretions are common, occurring singly or in rows. A few thin, sandy flags occur in the upper part of the beds. These shales are contrasted with the Genesee shale below by their lighter shade and their much less bituminous character, for the most part being highly fissile and breaking out into thin, sharp but small laminae. The lighter parts of the mass are easily eroded, being tenuous and clayey and the streams that flow down the hillside have cut numberless narrow, deep gullies in them, the sides of which are steep slopes of slippery shale. The concretions in the shale are frequently highly characteristic and are the source of most of the very abundant specimens of these bodies which are found scattered over the region and have been collected by the residents on account of their curious forms, suggestive of turtles, human skulls, hats and various other rounded objects. They not infrequently carry fossils in much better condition than found elsewhere in the beds, and these fossils of the concretions are more in accord with the singular fauna of the Genundewa limestone than are those of the shales. In the shales organic remains are of more frequent occurrence than in the Genesee shales beneath but they are seldom abundant.

This rock is shown in the lower part of all the ravines in the Middlesex valley north of the Goodrich gully. There is also a small outcrop by the roadside half a mile north of Rushville and along several small brooks in the southwest part of the town of Gorham. In the Snyder gully just above Woodville at the head of Canandaigua lake they are well shown, and also in the lake cliff at Woodville where their peculiar blocky structure, due to numerous joints, is finely displayed. The deeper parts of the ravines at Coye, Granger, Lapham, Cook and Hicks points and all of the other gullies between the head of the lake and Seneca point are in these shales; also the Seneca point ravine above the first cascade and the upper part of Victoria glen and Foster gully. Northerly exposures are also shown in

the bed of the creek at Cheshire. They enter largely into the composition of the lake wall on the east side from Genundewa south to Woodville, but here the rock exposures are extensively overgrown. In the Bristol valley they are displayed in the large ravine of Wilder creek and from there southward in the Reed and Packard ravines and in several other smaller gullies on both sides of the valley. The south branch of Beebe brook in the northwest corner of Bristol township flows through a small gully cut in the shales of this horizon, and in the town of Richmond the rocks are exposed in the cliffs of Mill gull. Here, a short distance above the outcrop of Genundewa limestone, the cliff walls are handsomely banded by alternating layers of black beds recurring among the blue gray layers.

Standish flags and shales

Thin, uneven, bluish gray flags and olive shales. This is a thin bed of rocks probably not exceeding 15 feet in thickness, but it has seemed entitled to distinctive designation because it marks a transition from the argillaceous shales of the West River beds into the arenaceous sedimentation, characterizing for the most part, the mass of the Portage strata. The beds were originally designated by the writer "transition shales" in recognition of the fact referred to. It is not a persistent deposit for any great distance from the region immediately under consideration. The mass, thinning out toward the west, disappears altogether in the Genesee valley and by its absence the overlying bed of black shales (Middlesex shales) is brought directly on the West River beds. The beds show some difference from those below in faunal content. Exposures are seen in the localities already mentioned where the outcrops are sufficiently continuous, specially in the Middlesex valley in the ravine 50 rods north of the Lee schoolhouse and in other ravines at the north to Middlesex Center, and on the west side of the valley in the Goodrich gully running up into South hill and ravines to the north; in the Canandaigua lake valley, in the Standish gully and the ravines from Woodville to Cook point, and in the upper

reaches of the ravines farther north; in Bristol hollow near the lower part of the Randall gully and also in the Reed and Wilder ravines.

Middlesex black shale

It has been customary to regard the Genesee group of strata as closing with the foregoing and to place the Middlesex shale at the base of the Portage series. This Middlesex shale is a very black, somewhat slaty shale with thin arenaceous gray flags in the upper and lower portions. When Professor Hall introduced the designation Genesee shale for the black shales in the Genesee river section, he expressed the opinion that eventually it might be found advisable to include them within the limits of the Portage formation. We have shown that on paleontologic grounds this is necessary, and it is clearly apparent that the geologic character of the deposit shows that the Genesee black shales are but an introductory phase of Portage sedimentation repeated in the Middlesex and Rhinestreet bands. The Middlesex shale attains a thickness of 35 feet where fully exposed in the Middlesex valley and decreases westward to 25 feet in the valley of Honeoye lake, just beyond the west line of these maps.

Fossils are of great rarity. Plant remains occur in the shales, and these have also afforded a single specimen of the goniatite *Sandbergeroceras synonum*. Occasionally a characteristic lamellibranch of the Cashagua shales above appears in the gray flags of the lower beds. This mass of black shale is continuous westward to Lake Erie but it decreases gradually in thickness till on the Lake Erie shore at the mouth of Pike creek there are but about 6 feet of it remaining. The rock is well exposed in the Middlesex valley in most of the ravines between the Lee schoolhouse and the village of Middlesex. It is seen on the roadside on the east side of the swamp at the head of the lake and in the Canandaigua lake valley by the road $1\frac{1}{2}$ miles south of Woodville, also on the road leading west at the head of the lake and in the Standish, Coye, Granger, Lapham, Cook, Hicks point and Seneca point ravines, by the side of the Academy road 1 mile south of Cheshire. In the Bristol valley it may be observed in

all the ravines already mentioned and in the Hamilton gully, Mill gull and Jason gull in the valley of Honeoye lake.

Cashaqua shale

This name was introduced by Professor Hall for the characteristic olive gray shales with occasional flags and sandstone as developed along the Cashaqua creek, a confluent of the Genesee river. As these beds are continuous from that point eastward to the area under consideration the term is completely applicable here. In this area this mass of shales attains a thickness of about 230 feet, and is mostly bluish gray and olive shale with a few thin dark layers and with two bands of thin sandstone and numerous flags in the lower part. Calcareous concretions and discontinuous concretionary layers occur in the upper part. As a whole the deposit in Ontario county is more arenaceous and less calcareous than that in the Genesee river section. In the lower 75 feet the more sandy beds are rarely fossiliferous, showing occasional lignites and frequently the object termed *Fucoides graphicus*. At about the middle of the series the shales become softer, and here the characteristic fauna of these Portage rocks is typically developed with numerous goniatites, Bactrites and lamellibranchs of the genera *Buchiola*, *Lunulicardium*, *Ontaria* etc. The character of this fauna is referred to in a subsequent paragraph. Above these more highly fossiliferous beds is a band of compact sandstone and hard shales which is succeeded by 57 feet of soft, blue and olive clay shales, characterized by nodular structure due to irregular concretions of lime carbonate of small size. Six feet above the sandstone is a singular concretionary limestone which is continuous in character, attains a thickness of about 6 inches and is a mass of red and greenish kramenzel abounding in goniatites and *Orthoceras*. This layer is so distinctive, both on account of its color, its contents and its composition that it is here designated as the

Parrish limestone. It appears first on the western boundary of the Naples valley and is continuous from there eastward as far as Big stream and Glen Eldredge on Seneca lake. Its place in

the succession is apparently indicated in the western part of the quadrangle by a row of fossiliferous spheric concretions which appear in the Bristol and Honeoye valleys.

The Cashaqua shale, flags and calcareous beds constitute the principal situs of the fauna of the rocks and their exposures can be studied to best advantage in the admirable outcrops on the east side of the Naples valley, specially in the great Parrish gully at Parrish, the Caulkins gully and other small ravines cutting back into Hatch hill. The rocks are also shown in the face of Hatch hill behind the fair-ground and southward. The west side of this valley also affords some admirable exposures as in the Lincoln gully and thence northward on the western slope of Canandaigua lake in scores of ravines and gullies and along the dugway roads as far north as Cheshire. They are also displayed in the upper parts of all the gullies in Bristol Center southward to nearly the end of the valley and along Egypt brook and its various branches in South Bristol and also in the upper part of Jason gull. In the Honeoye lake valley the decreasing proportion of the arenaceous layers toward the west is noticeable, the shales becoming more calcareous and concretionary. The Briggs and Hamilton gullies near the west line of the map in the Honeoye valley afford particularly favorable outcrops for study. Nearly all the Cashaqua shales are to be seen under specially favorable conditions along the Whetstone brook west of Honeoye village from the Livonia road to the falls at the Devil's Bedroom. Eastward of Naples they are found in Italy hollow at the mouth of the ravine which crosses the road at the Big Tree schoolhouse. In the Middlesex valley they are well seen in the Clark and Mower gullies and also in the Lee, Goodrich and other small ravines farther north toward Middlesex Center. In fact in these high lands of the southern part of the map wherever the relatively thin drift mantle has been transected by streams these beds are brought to light.

Rhinestreet black shale

Black slaty shale with a small proportion of blue shale and occasionally thin but lenticular sandstones. Thickness 18 feet on the eastern boundary of the quadrangle increasing to 30 feet at

the western. This tendency to increase westward is manifested beyond the area of the map, for we find the bed to be continuous from here to Lake Erie, where its thickness is more than 200 feet. It may be traced eastward to Seneca lake, where its thickness is but 1 foot.

The rock is essentially devoid of organic remains with the exception of fragments of plants, specimens of *Spathiocaris*, teeth of *Conodonts* and a few small *Lingulas*. These rocks are to be seen in Italy hollow in the ravine already referred to near the Big Tree schoolhouse, in the Naples valley at the foot of Hatch hill near the salt well, on both sides of the Naples and Middlesex valleys to Middlesex Center, and on the north side of Genundewa. The formation takes its name from the exposure on the road running from Naples to Seaman hill, on the west side, which is known locally as Rhinestreet and along which there are constant exposures of this formation. They may be seen also in the upper part of all the large ravines on the west side of Canandaigua lake to the iron bridge over the Foster gully, 2 miles south of Cheshire; in the Bristol valley in the ravines on both sides as far north as Bristol Center and about $\frac{1}{2}$ mile north of Boswells Corners; in the Honeoye valley in all the ravines between the Hancock farm and the foot of the lake.

Hatch shale and flags

Blue and olive shales with frequent thin layers of black shale and thin sandstones. The sandstones become more frequent and thicker in the upper part of the formation; the lower layers carry very symmetric calcareous concretions from 2 inches to 2 feet in diameter. This mass immediately overlying the Rhinestreet black shales, or the *second black band* of some of our reports, attains a thickness of 290 feet and its resistant character, due to the presence of many layers of hard sandstone and flags, is the fundamental cause of the highlands on the Naples quadrangle. These beds are equivalent in part to the Gardeau beds of Hall in the Genesee valley section, but there are reasons for not applying the latter term in the Naples meridian as it can not be employed with exactitude.

These upper beds occasionally carry the fossils of the Cassaqua shale, but in no place are they of frequent occurrence except occasionally in replaced condition in the calcareous concretions. Toward the more sandy middle and upper portions of the series plant remains are not infrequent and from these beds has been obtained a *Lepidodendron* of commanding proportions, taken from a horizon at the mouth of Grimes gully, Naples, 74 feet above the Rhinestreet shales. The specimen when taken out measured 15 feet in length from the root upward.

Exposures of these beds are found throughout the Naples valley and constitute the entire lower part of Hatch hill, in the Tannery gully just south of Naples and in the Grimes gully on the west side, also in the higher parts of the Caulkins, Parrish, Hoecker and Lincoln gullies and in all accessible ravines of the Naples and southern parts of the Middlesex valley. Along Canandaigua lake they are seen in the upper parts of the deeper ravines on the west side, south of the Academy tract, in Bristol valley in the upper parts of all the ravines between Boswells Corners and Bristol Center and in the Honeoye valley just west of the sheet between Hunts hollow and the Briggs gully.

Grimes sandstone

Compact or laminated, light bluish gray sandstones in layers 4 inches to 3 feet thick, separated by hard, blue gray shales. In the vicinity of the Tannery gully, $\frac{1}{2}$ mile south of the village of Naples, a part of the sandstone is highly calcareous owing to the presence of masses of molluscan shells, mostly in comminuted condition. Thickness about 50 feet. In the face of the precipice at the third falls of the Grimes gully and exposed in the escarpment on the east side of the ravine 10 feet above the water, is a thin layer of soft shale which has been found to contain *Buchiola retrostriata*, *Manticoceras pattersoni*, *Bactrites* and other typical members of the Naples fauna. This is its highest appearance in this section. Twenty-four feet higher and 9 feet below the crest of the falls occurs the Grimes sandstone which bears a brachiopod fauna with *Liorhynchus*, *Atrypa reticularis*, *Productella*,

Ambocoelia, *Leptostrophia mucronata*, etc.; the first appearance of this fauna in this section and to be regarded as an incursive appearance of the Ithaca fauna lying farther to the east. This formation lies 599 feet above the base of the Middlesex black shale and this is the thickness to be ascribed to the Portage formation in this meridian as formerly defined. In the Tannery gully on the east side of the Naples valley the upper beds have afforded a number of singular organisms associated together but not concurring with species of the characteristic Naples fauna. These are specially noted elsewhere and consist of the fossil *Paropsonema*, believed to be an aberrant echinoid, some forms of annelids described as *Protonympha* and *Palaeochaeta*, also a large *Orbiculoidea*, some strange and undescribed linguloids, etc. The division occurs also at the Naples reservoir, in the escarpment on Hatch hill, in the Caulkins gully and the quarry near it, at the top of the dugway on the Hunts hollow road, in the road near Freed's and along the hillside northward to Rhinestreet, also near the Muck place on Seaman hill and in the small ravine near the Gardner property, 2 miles north of Bristol Springs. In Bristol hollow it appears in the upper parts of the Randall and Reed gullies and on the north side of Worden hill; in the Honeoye valley on the hillside above E. Alger's property and northward to the upper part of the Briggs gully.

West Hill flags and shale

Light bluish gray sandstones or flags from 2 to 12 inches thick, separated by beds of dark blue, olive or black shale. The sandstones are sometimes quite calcareous owing to the presence of crinoid stems and other fossils usually in fragmentary condition. Thickness 550 feet. This heavy mass of arenaceous deposits like the Hatch beds below is partially equivalent to the Gardeau series of Hall as developed in the Genesee valley. It has however undergone a change faunistically, and remains of the Naples fauna are now no longer seen, though the rocks contain fossils in some measure; but these are largely brachiopodous and indicate continued presence of the Ithaca fauna. The sandstones are

quite sharply distinguished from the Grimes sandstones below on account of their thinner bedding and bluish color. This division is exposed in Italy hollow at the south end along Flint creek and in the Italy gully, in the Naples valley in the Tannery gully and Grimes gully. It is found on the south side of the road leading easterly across Deyo basin, 2 miles south of Naples, 5 or 6 rods from the Ingleside road and near the foot of the hill. Here it is an isolated exposure and its stratigraphic position can not be ascertained with precision. It is however not far from 100 feet above the top of the Grimes sandstone. At this spot it has produced a number of interesting fossils; *Hydnoceras tuberosum*, *H. variabile*, *Ceratodictya cincta*, *Hysteracanthus*, *Spirifer mesacostalis*, *Atrypa hystrix*, *Productella*, *Ambocoelia* etc. The same horizon is found near the residence of Charles S. Sutton on the north side of the road leading from Naples to West hollow and here also brachiopods are found. The same beds are seen on the lands of the Pottle estate, $1\frac{1}{2}$ miles north of the last named exposure. One of the sandstones here contains fossils in great abundance, principally of the same species as found in the Deyo basin and on the West hollow road. A survival of the Naples fauna is notable here in the presence of the species *Manticoceras oxy*. In the road leading northward on the top of Worden hill a ledge of sandstone is exposed on both sides that contains masses of brachiopods. This locality is about 1 mile north of the south line of Bristol township. On Hatch hill are outcrops in the lower part of the so called Three Cornered clearing near the top. The rocks are also seen at the upper end of the Hoecker and Lincoln gullies and on the hill north of the Seaman schoolhouse, and in many small ravines on the sides of High point, Frost hill and Gannett hill. They are also the surface rock over the principal part of the town of Canadice to the west of the sheet and extend over the tops of the ridges on both sides of the Bristol valley for a mile or two into the town of Bristol.

Highpoint sandstone

Light gray sandstones in layers from 3 inches to 4 feet in thickness separated by thin beds of hard blue shale. Some of the layers of the rock are compact and calcareous but the larger portion is laminated and sometimes shaly. Lenticular beds of impure limestone composed of crinoid stems and other fossils occur at High point and other outcrops. These sandstones are thinner and softer toward the east. Thickness 100 feet. These beds are nowhere sufficiently exposed to admit of detailed examination of the entire series and the upper and lower contact, but 50 to 75 feet of the formation project in the cliff at the south end of High point at an elevation of 1850 to 1925 feet A. T., and the talus that covers the strata at the base of the hill is principally composed of fallen slabs and blocks of the sandstone. In structure, texture and general appearance they differ from the Grimes sandstone only in being somewhat coarser and weathering to a lighter color but they likewise differ notably in their fossil contents. *Fucoides verticalis*, which is not seen in the lower rocks, is common throughout these beds. The most striking feature of this exposure consists of an irregular stratum of calcareous sandstone and conglomerate 7 feet thick where thickest and thinning out gradually around both sides of the hill. This is a mass of brachiopods, corals and crinoid stems cemented into a hard, compact layer that resists the effects of weather and at one place projects 12 feet beyond the soft sandstone beneath it. Several fallen slabs of this calcareous layer 10 to 15 feet across are to be seen at the foot of the escarpment and many others have been broken up and utilized in the construction of fireplaces in the pioneer days and later in the arches of furnaces beneath steam boilers, its resistance to the disintegrating effect of heat making the "High Point firestone" highly esteemed for these purposes in this locality. It has, however, now fallen into disuse. This highly fossiliferous layer is about 50 feet below the top of the sandstone. In it a well defined Chemung fauna with *Spirifer disjunctus* occurs together with species

which were originally described from the upper Devonian beds of Iowa, and attention is here directed to a more complete statement of the fossil contents of these beds in a subsequent paragraph. The rock is not exposed on the south or west sides of the depressions that isolate High point, though calcareous layers of somewhat similar character occur at about the same horizon in the cliff on the northwest end of Knapp hill and also in the escarpment near Mr J. Eldridge's residence on the road from Garlinghouse to Atlanta. Hard, dark shales and thin sandstones come in again at the top of the High point bluff and are slightly exposed in the fields above but no fossils were observed in them and nothing but their position distinguishes them from those below. On the south side of the Naples valley the Highpoint beds appear in some isolated outcrops on the north slope of Pine hill and in the bluff on the west side of Knapp hill and the thick sandstones that form the escarpments above the talus in the vicinity of McClarie's quarry on the dugway road just east of North Cohocton are in the same horizon, but the rock here is almost barren of fossils. They are also to be seen in Lyons hollow by the side of the road leading east, 2 miles south of Ingleside; in the upper part of Italy gully and on the tops of Worden and Gannett hills. Careful stratigraphic work has determined that the Highpoint sandstone is continuous with the original Portage sandstones of the Genesee valley, which in Professor Hall's section capped the Portage section there. It has also been pointed out that while these horizons are stratigraphically continuous the fauna is very different in the two sections. The Portage sandstones still carry the Naples fauna, while in the Naples region that fauna has long before this date been extinguished by the appearance, first of the Ithaca, then of the Chemung fauna from the east.

Prattsburg sandstone and shale

In the lower part of this division the sandstones are mostly olive-gray, rather soft and schistose or in thin even layers, and the shales are in part soft and blocky, similar in appearance to the Cashaqua shales. Layers of blue, olive and black shales occur.

Thickness from 200 to 225 feet. These beds lie in the horizon of the Wiscoy shales of the Genesee river section, which are beds there overlying the Portage sandstones but still carrying the Portage fauna though somewhat modified in character. There also they are overlain by strata carrying the Chemung fauna which appears first at Long Beards riffs with *Spirifer disjunctus*.

The upper part of the Prattsburg beds in the Naples region are light bluish gray sandstones, usually in lentils and compact or uneven layers. The interstratified shales are mostly blue and hard, but black and slaty layers occur frequently. These beds have a thickness of 300 to 400 feet in the higher land of the southern part of the quadrangle. The lower portion, or the equivalent of the Wiscoy horizon, is exposed in a small outcrop on the road leading from Marsh's Corners southward up Pine hill near the top, and a mile still farther east on the road leading from Ingleside to Lent hill is another exposure in approximately the same horizon, from which *Manticoceras oxy* has been obtained. Whitney's quarry on the southwest side of Pine hill, which has produced a large amount of flagstone laid for sidewalks in the village of Naples and adjoining towns, is in this horizon. It is exposed also along the dugway road leading up Lent hill southwest from Ingleside near the road on the east side of Pine hill, in the Woodworth quarry 2 miles south of North Cohocton, on Lent hill in the ravine west of the Wheaton farm, in the upper part of the Italy gully, and by the roadside 2 miles north of Prattsburg. The upper beds are seen in the Wheaton quarry on the hill south of Atlanta, by the roadside in several places in the vicinity of Lent Hill church and in numerous small outcrops on the high ridge between the Prattsburg valley and Lyons hollow.

SUCCESSION OF FOSSIL FAUNAS

Camillus shale

We know of no traces of organisms in these deposits except an occasional ostracode shell (*Leperditia*) and a trail made on the soft mud by such an organism. The sediments were laid down in a sea too shallow and too strongly saturated with brine and alkalis to encourage the existence of life.

Bertie waterlime

The fauna of these beds is that peculiar association of crustaceans which has made this horizon one of the most interesting in the entire series of the New York formations. Occasionally in the outcrops and more freely in the loose blocks of this rock scattered over the country south of the line of outcrop, are specimens of *Eurypterus remipes* Dekay and *Ceratiocaris acuminata* Hall, with abundant *Leperditias*, *Lingulas* and an occasional *Orbiculoidea*. Westward of this region specially in the exposure in the quarries of the Buffalo Cement Co. at Buffalo, and eastward in the towns of Sauquoit and Litchfield, Herkimer co., these crustaceans with others are found in great abundance and perfection, but in the intervening region they have thus far proved of rarer occurrence. The fauna of these merostome crustaceans is widely known as one marking the closing stages of Siluric time through northern latitudes on both hemispheres.

Cobleskill shale and dolomite

The fauna here is sparse but indicative of the relation of the horizon to its more typical eastward outcrops. The list of species at present known is:

Eurypterus, occasional fragments
Leperditia alta Conrad
L. scalaris Jones
Whitfieldella sulcata Vanuxem

Spirifer eriensis Grabau
Cyathophyllum hydraulicum Simpson

Oriskany sandstone

This rock carries no fossils in this district. At Union Springs, Cayuga co. is the nearest point where the characteristic fauna of the arenaceous deposits is developed with *Spirifer are-*

nosus Conrad, *Hipparionyx proximus* Vanuxem, *Meristella lata* Hall, *Chonostrophia complanata* Hall, etc. A few imperfect fossils have been found in the outcrops on Flint creek near Phelps Junction but mostly when the rock takes on the form of a thin quartzite or breccia as here it is devoid of fossils.

Onondaga limestone

Throughout the exposures of this rock fossils are abundant but they are not easily obtained because of the difficulty in setting them free of the matrix. Experience has shown that the endeavor to acquire the remains from the unweathered exposures is for the most part fruitless as well as arduous except where there are shale masses intercalated between the limestone beds. The fauna is specially profuse in corals but the agglomerations of these organisms which are seen in the lower beds of this district become immense coral plantations farther westward in the vicinity of Leroy, Genesee co. Nature has helped to solve the difficulties attending the extraction of these fossils by scattering over the county and through the soil southward innumerable blocks of this rock. The corals are partially silicified in the bed and on exposure become more so and the dissolution of the calcareous matrix makes the occurrence of silicified corals of this formation extremely common over much of the region covered by this map. The layers of the limestone that are associated with and more or less impregnated by the chert, weather into all sorts of irregular shapes according to the degree of dissemination of the lime throughout them and when this silicious rock has become thoroughly "rotten," that is, has lost all its lime, the silicious residuum retains with minutest precision the impressions of the organic contents. By the examination of such masses of rotten stone has the fauna in an important degree been made out, and an illustration of their significance is seen in the fact that these masses from Ontario county produced specimens of trilobites alone of which 55 drawings were made for the monograph of these organisms published as volume 7, *Palaeontology of New York*.

In these weathered blocks students of this fauna will find their material in most suitable form for study; these will not however

contribute to a knowledge of the zonal distribution of the species. Of this condition we know little; probably variations in range are so slight that the effort to ascertain them would produce a result in no way commensurate with the labor involved.

The student may expect to find in the Onondaga limestone of this district the following species:

Fishes

- Machaeracanthus peracutus Newberry*
M. sulcatus Newberry
Onychodus sigmoides Newberry

Crustaceans

- Acidaspis callicera Hall & Clarke*
Beyrichia subquadrata Jones
Bollia bilobata Jones
Cyphaspis diadema Hall & Clarke
C. hybrida Hall & Clarke
C. minuscula Hall
C. stephanophora Hall & Clarke
Dalmanites aegeria Hall
D. anchlops Green
D. bifidus Hall
D. calypso Hall
D. coronatus Hall
D. diurus Green
D. myrmecophorus Green
D. pygmaeus Hall & Clarke
D. selenurus Conrad
Eurychillina? reticulata Ulrich
Leperditia cayuga Hall
Lichas contusus Hall & Clarke
L. dracon Hall & Clarke
L. eriopsis Hall
L. gryps Hall & Clarke
L. hispidus Hall & Clarke
Moorea kirkbyi Jones
Palaeocreusia devonica Clarke
Phacops bombifrons Hall
P. cristata var. pipa Hall & Clarke
Phaethonides gemmaeus Hall & Clarke
P. navicella Hall & Clarke
Primitia clarkel Jones
Proetus clarus Hall
P. crassimarginatus Hall
P. folliceus Hall & Clarke

- P. microgemma Hall & Clarke*
P. ovifrons Hall & Clarke
P. stenopyge Hall & Clarke
P. verneuilli Hall & Clarke
Turrilepas cancellatus Hall & Clarke
T. flexuosus Hall & Clarke

Cephalopods

- Cyrtoceras citum Hall*
Gomphoceras absens Hall
G. eximium Hall
Gyroceras cyclops Hall
G. laciniosum Hall
G. matheri Conrad
G. trivolve Conrad
G. undulatum Vanuxem
Orthoceras geneva Clarke
O. inoptatum Hall
O. profundum Hall
O. sceptrum Hall
O. thoas Hall

Pteropods

- Hyolithus ceratophilus Clarke*
H. ligea Hall
Tentaculites scalariformis Hall

Gastropods

- Bellerophon curvilineatus Conrad*
B. pelops Hall
Callonema lichas Hall
Diaphorostoma lineatum Conrad
D. turbinatum Hall
D. unisulcatum Conrad
Euomphalus decewi Billings
E. laxus Hall
Loxonema laxum Hall
L. pexatum Hall
L. robustum Hall
L. sicula Hall
Murchisonia intercedens Hall
Naticopsis compacta Hall

Platyceras ammon Hall
P. argo Hall
P. carinatum Hall
P. concavum Hall
P. crassum Hall
P. cymbium Hall
P. dentalium Hall
P. dumosum Conrad
P. erectum Hall
P. fornicatum Hall
P. nodosum Hall
P. perelegans Hall
P. rectum Hall
P. subrectum Hall
P. undatum Hall
Pleurotomaria adjutor Hall
P. delicatula Hall
P. hebe Hall
P. lucina Hall
P. plena Hall
P. quadrilix Hall
P. unisulcata Conrad
Strophostylus varians Hall
Turbo shumardi de Verneuil

Lamellibranchs

Aviculopecten pectiniformis Conrad
A. ignotus Hall
Conocardium cuneus Conrad
C. trigonale Conrad
Cypricardinia indenta Conrad
Limoptera pauperata Hall
Lyropecten dardanus Hall
Megambonia cardiformis Hall
Modiomorpha clarens Hall
Nyassa elliptica Hall
Palaeopinna recurva Hall
Panenka multiradiata Hall
Paracyclas elliptica Hall
Pterinopecten insons Hall
P. undosus Hall

Brachiopods

Amphigenia elongata Hall
Atrypa reticularis Linné
Camarotoechia billingsi Hall
C. inequiplcata Hall
C. royana Hall
C. tethys Billings
Centronella glansfagea Billings
Chonetes acutiradiatus Hall

C. arcuatus Hall
C. lineatus Hall
Chonostrophia reversa Whitfield
Coelospira camilla Hall
Leptaena rhomboidalis Wilckens
Leptocoelia acutiplicata Conrad
Leptostrophia perplana Conrad
Lingula desiderata Hall
Meristella doris Hall
M. nasuta Conrad
M. scitula Hall
Orthothetes pandora Billings
Pentagonia unisulcata Conrad
Pentamerella arata Conrad
Productella navicella Hall
P. shumardiana Hall
Rhipidomella lenticularis Vanuxem
R. semele Hall
Schizophoria propinqua Hall
Spirifer acuminatus Conrad
S. arctosegmentus Hall
S. disparilis Hall
S. divaricatus Hall
S. duodenarius Hall
S. fimbriatus Conrad
S. gregarius Clapp
S. macer Hall
S. macrothyris Hall
S. manni Hall
S. raricosta Conrad
S. varicosus Hall
Stropheodonta ampla Hall
S. concava Hall
S. demissa Conrad
S. hemisphaerica Hall
S. inequiradiata Hall
S. inequistriata Conrad
S. patersoni Hall
S. textilis Hall
Terebratula lens Hall

Crinoids

Codaster pyramidatus Hall
Cyathocrinus bulbosus Hall
Edriocrinus pyriformis Hall
Myrtillocrinus americanus Hall

Corals

Alveolites squamosus Billings
Aulacophyllum princeps Hall
Cladopora cryptodens Billings

<i>C. laqueata Rominger</i>	<i>F. tuberosus Rominger</i>
<i>C. labiosa Billings</i>	<i>Heliophyllum annulatum Hall</i>
<i>Cyathophyllum corniculum Edwards & Haime</i>	<i>H. cancellatum Hall</i>
<i>C. juvenis Rominger</i>	<i>H. exiguum Billings</i>
<i>C. robustum Hall</i>	<i>Michelinia cylindrica Edwards & Haime</i>
<i>C. validum Hall</i>	<i>Pleurodictyum convexum d'Orbigny</i>
<i>Cylindrophyllum elongatum Simpson</i>	<i>Ptychophyllum striatum Hall</i>
<i>Cystiphyllum scalatum Hall</i>	<i>Syringopora nobilis Billings</i>
<i>C. sulcatum Billings</i>	<i>S. perelegans Billings</i>
<i>Eridophyllum simcoense Billings</i>	<i>Zaphrentis complanata Hall</i>
<i>Favosites canadensis Billings</i>	<i>Z. fastigata Hall</i>
<i>F. emmonsii Rominger</i>	<i>Z. gigantea Edwards & Haime</i>
<i>F. epidermatus Rominger</i>	<i>Z. tabulata Hall</i>
<i>F. hemisphaericus Troost</i>	

Marcellus shale

With the close of the limestone epoch there was an abrupt change in the sedimentation, and here begins a new series of sediments and very distinct aggregate of faunas. The Marcellus shale introduces black, carbonaceous and pyritous sedimentation, evincing a deepening of the waters and a foul bottom, over which but few forms of life prevailed and these depauperated in size and of very tenuous shell. All the species here found are the apparent proper accompaniments of such bionomic conditions; *Liorhynchus limitaris*, which puts in an appearance during this stage of the Devonian wherever the sediments become highly charged with bituminous matter; *Chonetes mucronatus*, *C. lepidus*, *Strophalosia truncata*, *Pleurotomaria rugulata*, *Styliolina fissurella* and *Orthoceras subulatum* also follow these conditions. Occasionally members of the congeries have apparently dropped into the deposits from the higher and more prolific zone of life.

The exposures at Padelford and along Mud creek have furnished the following:

<i>Orthoceras subulatum Hall</i>.....c	<i>C. mucronatus Hall</i>.....r
<i>Styliolina fissurella Hall</i>.....cc	<i>Strophalosia truncata Hall</i>.....cc
<i>Pleurotomaria rugulata Hall</i>.....c	<i>Liorhynchus limitaris Vanuxem</i> ...cc
<i>Nuculites oblongatus Conrad</i>.....c	<i>L. multicosta Hall</i>.....r
<i>Chonetes lepidus Hall</i>.....c	

Stafford limestone

We have shown in papers relating specially to this deposit¹ that its very extensive fauna is that of the Skaneateles, Canandaigua and Moscow shales in unusually favorable development. . It was the first appearance in this region of that fauna, but for western New York as a whole, the second invasion of this Hamilton fauna from the west into the Appalachian basin. For a full account of the formation and its contents where best developed, reference is made to the papers cited and to Elvira Wood's discussion of the fauna of the Stafford limestone at Lancaster, Erie co. [Bul. 49, p.139]. The absence of outcrops of the rock over the area of this map restricts the representation of its fauna to such species as are to be found in the loose blocks, but the following is a list of the species which may be expected from the formation.

Undetermined plates and scales of fishes

Spirorbis

Worms

Crustaceans

Homalonotus dekayi Green

Phacops rana Green

Cryphaeus boothi Green

C. boothi var. calliteles Green

Proetus macrocephalus Hall

Cyphaspis craspedota Hall & Clarke

Primitiopsis punctulifera Hall

Cephalopods

Nautilus liratus Hall

N. cf. magister Hall

Nephriticeras buclnum Hall

Orthoceras subulatum Hall

O. aegae Hall

O. marcellense Vanuxem

O. fenestrulatum Clarke

O. staffordense Clarke

O. erlense Hall

Pteropods

Tentaculites gracillistriatus Hall

Styliolina fissurella Hall

Gastropods

Platyceras attenuatum Hall

P. bucculentum Hall

Cyrtolites mitella Hall

Bellerophon lyra Hall

Diaphorostoma lineatum Conrad

Pleurotomaria lucina Hall

P. rugulata Hall

P. itys Hall

P. capillaria Conrad

P. sulcomarginata Conrad

Loxonema hamiltoniae Hall

Onychochilus nitidulus Clarke

Lamellibranchs

Pterinopecten exfoliatus Hall

Actinopteria muricata Hall

Liopteria laevis Hall

Cypricardinia indenta Conrad

Panenka mollis var. costata Hall

P. radians Conrad

Pterochaenia fragilis Hall

Brachiopods

Terebratula lincklaeni Hall

Cryptonella planirostris Hall

¹N. Y. State Geol. 8th An. Rep't. 1889. p.60; and N. Y. State Mus. Bul. 49. 1901. p.130.

C. rectirostris Hall
Camarotoechia sappho Hall
C. horsfordi Hall
C. dotis Hall
C. prolifica Hall
C. pauciplicata Wood
Spirifer audaculus Conrad
S. fimbriatus Conrad
S. subumbona Hall
Ambocoelia nana Grabau
Meristella barrisi Hall
Trematospira gibbosa Hall
Strophalosia truncata Hall
Productella spinulicosta Hall
P. shumardiana Hall
Chonetes mucronatus Hall
C. scitulus Hall
C. lepidus Hall
Tropidoleptus carinatus Conrad
Stropheodonta inaequistriata Conrad
Leptostrophia perplana Conrad

Orthothetes chemungensis Conrad
O. arctostriatus Hall
Rhipidomella vanuxemi Hall
R. cycias Hall
Crania crenistriata Hall
C. recta Wood
Craniella hamiltoniae Hall

Bryozoans

Hederella canadensis Nicholson
H. cirrhosa Hall
Reptaria stolonifera Rolle

Blastoids

Nucleocrinus lucina Hall

Corals

Favosites placenta Hall
Stereolasma rectum Hall
Striatopora limbata Conrad
Romingeria
Alulopora

Cardiff shale

The darker beds which chiefly comprise this mass bear but few traces of organic remains. Conditions here as in the Marcellus shale were not favorable to life. Its species are

Orbiculoidea minuta Hall

| *Liorhynchus limitaris* Vanuxem

The more calcareous and upper beds, which form blue black harder layers, show an addition of representatives from the constantly nearer zone of prolific life in the overlying shales. These have been taken from the beds at Chapinville and along Mud creek and are:

<i>Rhinocaris veneris</i> Hall & Clarke. r	| <i>Styliolina fissurella</i> Hall..... c
<i>Phacops rana</i> Green..... r	| <i>Pleurotomaria rugulata</i> Hall..... c
<i>Orthoceras nuntiolides</i> Clarke..... r	| <i>Nucullites oblongatus</i> Conrad..... c
<i>Gomphoceras mitriforme</i> Clarke.. r	| <i>Buchiola stuprosa</i> Clarke..... r
<i>Bactrites clavus</i> Hall..... c	| <i>Pterochaenia fragilis</i> Hall..... r
<i>Tornoceras discoideum</i> Conrad.... c	| <i>Strophalosia truncata</i> Hall..... c

Skaneateles shale

The fauna of these beds is very sparse, a few species characteristic of the black beds intermingled with some from the more calcareous beds above. As the mass represents essentially a

phase of transition from the condition of the black sediments to those of shallower and clearer water deposit, the fauna is also mixed and transitional. It contains:

Phacops rana <i>Green</i>	rr	Chonetes setiger <i>Hall</i>	c
Styrololina fissurella <i>Hall</i>	c	Spirifer mucronatus <i>Conrad</i>	r
Pleurotomaria rugulata <i>Hall</i>	c	Ambocoella umbonata <i>Conrad</i>	c
Lanulicardium curtum <i>Hall</i>	r	Liorhynchus limitaris <i>Vanuxem</i> ..	c
Nuculites oblongatus <i>Conrad</i>	c	L. multicosta <i>Hall</i>	c

Canandaigua shale and limestone

With these beds begins the profuse development of the calcareous Hamilton shales. Though the rocks of this stage are treated as a unit on the map their faunas may be here considered in two divisions, that of (1) the Centerfield limestones or the calcareous beds at the base, (2) the upper division or the Canandaigua shales.

1 In the Centerfield limestones, best developed on Shaffer creek and underlying all the northern part of the village of Canandaigua, the following species have been noted:

Worms		Cyrtolites mitella <i>Hall</i>	
Arabellites	r	Platyceras auriculatum <i>Hall</i>	c
Oeonites	r	P. symmetricum <i>Hall</i>	c
Eunicites	r	P. thetis <i>Hall</i>	c
Spirorbis angulatus <i>Hall</i>	c	F. subspinosus <i>Hall</i>	
Cornulites tribulis <i>Hall</i>	r	Pleurotomaria itys <i>Hall</i>	
Crustaceans		P. lucina <i>Hall</i>	
Phacops rana <i>Green</i>	cc	P. disjuncta <i>Hall</i>	r
Dalmanites boothi <i>Green</i>	cc	Loxonema delphicola <i>Hall</i>	
D. boothi var. calliteles <i>Green</i> ...	cc	L. hamiltoniae <i>Hall</i>	
Proetus rowi <i>Green</i>	cc	Lamellibranchs	
P. macrocephalus <i>Hall</i>		Mytilarca oviformis <i>Conrad</i>	c
Cyphaspis ornata <i>Hall</i>		Microdon bellistriatus <i>Conrad</i>	
C. ornata var. baccata <i>Hall & Clarke</i>		Conocardium crassifrons <i>Conrad</i>	
C. craspedota <i>Hall & Clarke</i>		Cypricardinia indenta <i>Conrad</i> ...	c
Turrilepas devonica <i>Clarke</i>		Actinopteria decussata <i>Conrad</i> ..	c
T. squama <i>Hall & Clarke</i>		Aviculopecten princeps <i>Conrad</i> ..	c
T. nitidula <i>Hall & Clarke</i>		Lingula leana <i>Hall</i>	r
T. foliata <i>Hall & Clarke</i>		L. densa <i>Hall</i>	
T. tenera <i>Hall & Clarke</i>		Crania crenistria <i>Hall</i>	
Schizodiscus capsa <i>Clarke</i>		Craniella hamiltoniae <i>Hall</i>	c
Gastropods		Rhipidomella penelope <i>Hall</i>	c
Bellerophon pelops <i>Hall</i>		Brachiopods	
		R. vanuxemi <i>Hall</i>	c

<i>Orthothetes arctostriatus Hall..</i>	c	<i>Orinotæ</i>	
<i>Sirophæodonta concava Hall</i>		<i>Platycrinus eboraceus Hall.....</i>	r
<i>S. demissa Conrad.....</i>	c	<i>Megistocrinus ontario Hall.....</i>	r
<i>S. inequistriata Conrad.....</i>	c	<i>Corals</i>	
<i>Pholidostrophia nacrea Hall.....</i>	c	<i>Zaphrentis halli Edwards &</i>	
<i>Leptostrophia perplana Conrad</i>		<i>Haime</i>	c
<i>Chonetes coronatus Conrad.....</i>	c	<i>Z. simplex Hall</i>	
<i>C. deflectus Hall</i>		<i>Cystiphyllum varians Hall</i>	
<i>Productella navicella Hall</i>		<i>C. conifollis Hall</i>	
<i>P. spinulicosta Hall</i>		<i>C. americanum Edwards &</i>	
<i>Spirifer angustus Hall.....</i>	r	<i>Haime</i>	cc
<i>S. divaricatus Hall</i>		<i>Cyathophyllum robustum Hall... c</i>	
<i>S. fimbriatus Conrad.....</i>	c	<i>C. nanum Hall</i>	
<i>S. audaculus Conrad.....</i>	c	<i>C. conatum Hall.....</i>	c
<i>S. mucronatus Conrad</i>		<i>Amplexus hamiltoniae Hall</i>	
<i>S. consobrinus d'Orbigny</i>		<i>Heliophyllum halli Edwards &</i>	
<i>Ambocoella umbonata Conrad... c</i>		<i>Haime</i>	cc
<i>Nucleospira concinna Hall.....</i>	cc	<i>H. halli var. irregulare Hall.... c</i>	
<i>Trematospira hirsuta Hall</i>		<i>H. halli var. reflexum Hall</i>	
<i>Meristella haskinsi Hall.....</i>	cc	<i>H. obconicum Hall</i>	
<i>Atrypa reticularis Linné</i>		<i>H. confuens Hall.....</i>	r
<i>Camarotoechia dotis Hall</i>		<i>Favosites placenta Rominger.... cc</i>	
<i>C. horsfordi Hall.....</i>	c	<i>F. arbusculus Hall</i>	
<i>C. prolifica Hall</i>		<i>F. argus Hall.....</i>	c
<i>C. sappho Hall</i>		<i>Alveolites goldfussi Billings.... c</i>	
<i>Pentamerella pavilionensis Hall</i>		<i>Pleurodictyum stylopore Eaton</i>	
<i>Cryptonella planirostris Hall</i>		<i>Striatopora limbata Eaton..... c</i>	
<i>C. rectirostris Hall.....</i>	c		

Canandaigua shales proper

The beds above the "basal limestones" as they were originally termed by the writer, carry a less profuse fauna. The species assembled in the following list are from more numerous outcrops than the foregoing but, save at the very top of the formation just beneath the Tichenor limestone, they are seldom if ever as abundant in any single locality. There are some noteworthy differences in the composition of the faunas of these two parts of the Canandaigua beds, which are below singled out in special lists. The fossils herein are:

<i>Crustaceans</i>	<i>Worms</i>
<i>Phacops rana</i> <i>Green</i>	<i>Spirorbis angulatus</i> <i>Hall</i>
<i>Dalmanites boothi</i> <i>Green</i>	<i>Cephalopods</i>
<i>Proetus macrocephalus</i> <i>Hall</i>	<i>Orthoceras exile</i> <i>Hall</i>
Ostracodes of the genera	<i>O. nuntium</i> <i>Hall</i> c
<i>Beyrichia</i> , Entomls, <i>Primitia</i>	<i>O. crotalus</i> <i>Hall</i> r
and <i>Bollia</i> in the lower shales. cc	<i>Gyroceras liratum</i> <i>Hall</i>
<i>Estheria pulex</i> <i>Clarke</i> r	<i>Tornoceras unilangulare</i> <i>Conrad</i> .. r
	<i>Bactrites tenuicinctus</i> <i>Hall</i>

Pteropods

- Styliolina fissurella* Hall..... c
Hyolithus acilis Hall..... r

Gastropods

- Bellerophon leda* Hall..... c
B. lyra Hall..... r
B. acutilira Hall..... r
Cyrtolites mitella Hall..... r
Platyceras symmetricum Hall... c
P. erectum Hall
P. conicum Hall
P. attenuatum Hall
P. thetis Hall
P. bucculentum Hall..... c
P. carinatum Hall..... c
P. echinatum Hall
Pleurotomaria capillaria Conrad. c
P. itys Hall..... c
P. trillix Hall
Loxonema delphicola Hall
Diaphorostoma lineatum Conrad. cc
Cyclonema hamiltoniae Hall
C. multilira Hall
Euomphalus rudis Hall
Murchisonia turricula Hall..... r
Macrochellus hebe Hall

Lamellibranchs

- Mytilarca oviformis* Conrad
Macrodon hamiltoniae Hall
Microdon bellistriatus Conrad
Buchiola halli Clarke
Cypricardinia indenta Conrad
C. pygmaea Hall
Grammysia arcuata Hall
Goniophora acuta Hall
Modiomorpha complanata Hall
M. concentrica Conrad
M. macilenta Hall
Nuculites oblongatus Conrad
Aviculopecten princeps Conrad
Palaeonello constricta Conrad
P. emarginata Conrad
P. fecunda Hall
P. plana Hall
P. tenuistriata Hall

Brachiopods

- Craniella hamiltoniae* Hall
Rhipidomella penelope Hall..... c
R. vanuxemi Hall..... cc
Orthothetes pandora Billings
Stropheodonta concava Hall
S. inequistriata Conrad..... cc
S. junia Hall..... c
Pholidostrophia naerea Hall
Leptostrophia perplana Conrad.. cc
Chonetes coronatus Conrad..... c
C. lepidus Hall
C. deflectus Hall
C. scitulus Hall
Productella navicella Hall
P. tullia Hall
Spirifer angustus Hall
S. fimbriatus Conrad..... c
S. granulosus Conrad..... c
S. audaculus Conrad
S. marcyi Hall
S. mucronatus Conrad..... c
S. consobrinus d'Orbigny
Ambocoelia umbonata Conrad... cc
A. praeumbona Hall
Cyrtina hamiltonensis Hall
Nucleospira concinna Hall..... cc
Trematospira hirsuta Hall..... c
T. nobilis Hall
Trigleria lepida Hall
Meristella haskinsi Hall
Athyris spiriferoides Eaton..... c
Camarotoechia congregata Conrad
C. sappho Hall
Liorhynchus multicosta Hall... r
L. quadricostatus Vanuxem..... r
Pentamerella pavillonensis Hall.. c
Cryptonella rectirostris Hall
Terebratula lincklaeni Hall
Tropidoleptus carinatus Conrad.. cc

Crinoids

- Nucleocrinus lucina* Hall
Dolatocrinus glyptus Hall
D. liratus Hall

On comparing these lists of species we find that while they are essentially homogeneous there are certain characteristic differences.

Centerfield limestone

Profusion of Trilobites representing all species of the Hamilton fauna except *Homalonotus dekayi*. Cirripedes and Schizodiscus

Cephalopods rare or absent

Bellerophon pelops

Platycerasc

Pleurotomaria lucina

P. disjuncta

Actinopteria decussata

Lingulasc

Pholidostrophia nacreata.....cc

Leptostrophia perplana.....r

Spirifer divaricatus

Corals very abundant forming a well marked plantation

Canandaigua shale

Trilobites relatively rare, the only common species *Phacops rana*, *Dalmanites boothi*, *Proetus macrocephalus*, *H. dekayi*. Other crustacea, except ostracodes rare or absent
Orthoceras, *Gyroceras*, *Bactrites*, *Tornoceras*

B. leda

B. lyra

B. acutilira

Platycerascc

Diaphorostoma lineatum.....c

Murchisonia

Macrochilus

Cyclonema

Modiomorpha complanata

M. concentrica

M. macilenta

Goniophora acuta

Grammysia arcuata

Palaeoneilo constricta, *emarginata*, *fecunda*, *plana*, *tenuistriata*

P. nacreatar

L. perplanacc

Trematospira nobilis

Athyris spiriferoides

Trigleria lepida

Tropidoleptus carinatus

Corals quite rare

Future investigations may obliterate some of these differences yet there will doubtless remain a distinction in the upper and lower elements of this fauna though these are bound together by a multitude of identities.

Tichenor limestone

Fossils are extremely few in this layer of semicrystalline gray limestone. They are frequently replaced wholly or in part by

celestite and hence at times make very striking specimens. They are:

Phacops rana <i>Green</i>	Lyriopecten orbiculatus <i>Hall</i>
Orthoceras caelamen <i>Hall</i>	Spirifer mucronatus <i>Conrad</i>
O. exile <i>Hall</i>	Spirophyton typus <i>Hall</i>

The last named object covers surfaces of the rock when inclined to be shaly.

Moscow shales

Lower division

The Moscow shales are well divided into subequal parts by the Menteth limestone and as there is a lithologic difference in the two on account of the gradual loss of calcareous content, we may contrast the faunas of these divisions. Lower beds:

Crustaceans

Phacops rana *Green*.....ccc
 Dalmanites boothi *Green*.....c
 Proetus macrocephalus *Hall*
 Homalonotus dekayi *Hall*

Worms

Spirorbis angulatus *Hall*

Cephalopods

Orthoceras nuntium *Hall*
 Gyroceras litratum *Hall*
 Tornoceras unilangulare *Conrad*
 Bactrites tenuicinctus *Hall*

Pteropods

Tentaculites bellulus *Hall*
 Hyolithus acilis *Hall*

Gastropods

Bellerophon leda *Hall*
 B. patulus *Conrad*
 B. thalia *Hall*
 Platyceras carinatum *Hall*
 P. conicum *Hall*
 P. thetis *Hall*
 Pleurotomaria itys *Hall*
 Loxonema delphicola *Hall*
 Diaphorostoma lineatum *Conrad*.ccc
 Cyclonema trillix *Hall*

Lamellibranchs

Mytilarca oviformis *Conrad*
 Macrodon hamiltoniae *Hall*
 Microdon bellistriatus *Conrad*
 Cypricardina indenta *Conrad*

C. pygmaea *Hall*
 Grammysia arcuata *Conrad*
 G. bisulcata *Conrad*
 Gonioophora acuta *Hall*
 Modiomorpha concentrica *Conrad*
 Aviculopecten parillis *Conrad*
 Palaeonello fecunda *Hall*
 P. muta *Hall*
 P. plana *Hall*
 P. tenuistriata *Hall*
 Actinopteria decussata *Hall*.....c

Brachiopods

Craniella hamiltoniae *Hall*
 Crania crenistria *Hall*
 Pholidops hamiltoniae *Hall*
 Rhipidomella penelope *Hall*
 R. vanuxemi *Hall*.....c
 Stropheodonta concava *Hall*.....c
 S. inequistriata *Hall*.....c
 S. junia *Hall*.....c
 Leptostrophia perplana *Conrad*...cc
 Chonetes coronatus *Conrad*
 C. deflectus *Hall*
 Productella papulata *Hall*
 P. spinullicosta *Hall*
 Spirifer marcyi *Hall*
 S. mucronatus *Conrad*.....c
 S. consobrinus *d'Orbigny*
 Ambocoelia umbonata *Conrad*
 Nucleospira concinna *Hall*
 Trematospira gibbosa *Hall*
 Meristella haskinsi *Hall*
 Athyris spiriferoides *Eaton*.....c

Atrypa reticularis Linné.....c
Camarotoechia congregata Conrad
C. prolifica Hall
Pentamerella pavilionensis Hall...cc
Cryptonella planirostris Hall
C. rectirostris Hall
Tropidoleptus carinatus Conrad...cc

Crinoids

Platycrinus sp.
Megistocrinus depressus Hall
M. ontario Hall
Thylacocrinus clarkel W. & S.
Ancyrocrinus bulbosus Hall
Dolatocrinus liratus Hall
D. intermedius Hall
D. glyptus Hall
D. troostii Hall

Aorocrinus cauliculus Hall
A. pocillum Hall
A. praecursor Hall
Eleutheroocrinus whitfieldi Hall
Gennaeocrinus eucharis Hall
G. nyssa Hall
Gilbertsocrinus spinigerus Hall
Melocrinus gracilis W. & S.
Poteriocrinus diffusus Hall
P. nereus Hall
P. nycteus Hall
Poteriocrinus sp.
Rhodocrinus gracilis Hall
R. spinosus Hall
R. nodulosus Hall
Nucleocrinus lucina Hall
Pentremites leda Hall

Menteth limestone

In this thin layer the species of the fauna are crowded together in great numbers. Several years ago the late Prof. Charles E. Beecher of Yale University collected at the localities of this interesting formation, and the etchings from the material thus gathered have been studied and identified by Percy E. Raymond of the Carnegie Museum, Pittsburg. Mr Raymond is about to publish some account of the fauna and he has permitted me to give here his list of species determined to which I have added a few not recognized by him.

Worms

Spirorbis angulatus Hall
S. spinuliferus Nich.
Cornulites tribulis Hall
Cornulites sp. nov.
Autodetus lindstroemi Clarke
Autodetus sp. nov.
Proetus rowi Green
P. macrocephalus Hall
Cyphaspis ornata Hall
Homalonotus dekayi Green
Phacops rana Green
Cryphaeus boothi Green

Crustaceans

Primitiopsis punctillifera Hall
Kirkbya parallela Ulrich
Strepula sigmoidalis Jones

Isochillina lineata Jones
I. (?) fabacea Jones
Primitia seminulus Jones
Octonaria stigmata Ulrich
Ctenobolina papillosa Ulrich
Beyrichia kolmodini Jones
Halliella retifera Ulrich
Moorea bicornuta Ulrich
Ostracoda—several unidentified species

Cephalopods

Orthoceras sp. ind.

Pteropods

Styliola sp. und.
Tentaculites bellulus Hall
Hyolithes acilis Hall

Gastropods

Loxonema hamiltoniae Hall
Pleurotomaria capillaria Conrad
Cyclonema hamiltoniae (?) Hall
Bellerophon leda Hall
Platyceras bucculentum Hall
P. carinatum Hall
P. symmetricum Hall
P. thetis Hall
Diaphorostoma lineatum Conrad

Lamellibranchs

Nuculites oblongatus Conrad
N. triquetus Conrad
Nucula corbuliformis Hall
Palaeonello constricta Conrad
Conocardium eboraceum Hall
Actinopteria decussata Hall
Aviculopecten exacutus Hall
A. princeps Conrad
A. scabridus Hall
Pterinopecten intermedius Hall
P. hermes Hall
P. regularis Hall
P. conspectus Hall
Lyrlopecten orbiculatus Hall
Modiomorpha alata Conrad
Cypricardella bellistriata Conrad
Cypricardinia indenta Conrad
Nyassa arguta Hall

Brachtopods

Lingula punctata Hall
Lingula sp. ind.
Pholidops oblata Hall
P. hamiltoniae Hall
Crania crenistriata Hall
Cranella hamiltoniae Hall
Camarotoechia congregata Conrad
C. horsfordi Hall
C. sappho Hall
Trigleria lepida Hall
Eunella lincklaeni Hall
Tropidoleptus carinatus Conrad
Atrypa reticularis Linn.
Cyrtina hamiltonensis Hall
Spirifer mucronatus Conrad
S. audaculus Conrad
S. granulatus Conrad
S. consobrinus d'Orb.

S. sculptis Hall
S. fimbriatus Conrad
Ambocoella umbonata Conrad
Nucleospira concinna Hall
Athyris spiriferoides Eaton
Stropheodonta concava Hall
S. demissa Conrad
S. inequistriata Conrad
S. junia Hall
Leptostrophia perplana Conrad
Pholidostrophia lowensis Owen.
Orthothetes chemungensis pectina-
ceus Hall
O. chemungensis arctistriatus Hall
O. bellulus Clarke
Chonetes coronatus Conrad
C. mucronatus Hall
C. scitulus Hall
C. deflectus Hall
C. robustus Raymond
Strophalosia truncata Hall
Productella spinulicosta Hall
Rhipidomella penelope Hall
R. vanuxemi Hall

Bryozoans

Ascodictyum stellatum N. & E.
Pinacotrypa plana Hall
Monotrypa fruticosa Hall
Monotrypa sp. und.
Fenestella emaciata Hall
Reteporina striata Hall
Isotrypa sp. und.
Hemitrypa cribrosa Hall
Polypora fistulata Hall
P. multiplex Hall
Rhombopora tortilinea Hall
Streblotrypa hamiltonensis Nich.
Ptilodictya plumea Hall
Cystodicta incisurata Hall
Taenloporella exigua Nich.
Acrogenia prolifera Hall
Lichenalia stellata Hall
Palescharea reticulata Hall

Corals

Heliophyllum halli E. & H.
Michelinia stylopore Eaton
Aulopora serpens Goldf.
Ceratopora dichotoma Grabau
C. jacksoni Grabau

Moscow shales*Upper division*

Fossils in these beds are less profuse though more numerous in species. They are quite uniformly distributed through the lower portion but farther up become arranged in thin beds separated by more or less wide intervals of barren shales.

Thin layers of limestone in these upper shales carry agglomerated masses of fossils.

Crustaceans

Phacops rana Green.....c
Cryphaeus boothi Green
Proetus macrocephalus Hall
Homalonotus deKayi Green

Worms

Spirorbis angulatus Hall

Cephalopods

Orthoceras exille Hall
O. emaceratum Hall
O. nuntium Hall
O. crotalus Hall
Gyroceras liratum Hall
Bactrites tenuicinctus Hall

Pteropods

Styliolina fissurella Hall
Ilyolithus acilis Hall

Gastropods

Bellerophon leda Hall
Platyceras carinatum Hall
P. echinatum Hall
P. erectum Hall
P. rectum Hall
P. symmetricum Hall
Pleurotomaria capillaria Conrad
P. itys Hall
P. lucina Hall
P. rotalia Hall
Loxonema delphicola Hall
Diaphorostoma lineatum Conrad

Lamellibranchs

Macrodon hamiltoniae Hall
Microdon bellistriatus Conrad
Cypricardinia indenta Conrad
Grammysia arcuata Hall
G. bisulcata Conrad
Goniophora hamiltonensis Hall

Modiomorpha macilenta Hall

Nucula corbuliformis Hall

N. lirata Conrad

Nuculites oblongatus Conrad

Orthonota carinata Conrad

O. parvula Hall

O. undulata Conrad.....cc

Palaeonello constricta Conrad

P. tenuistriata Hall

Pholadella radiata Hall

Phthonia nodocostata Hall

Sanguinolites solenoides Hall

Tellinopsis subemarginata Conrad

Brachiopods

Lingula punctata Hall.....cc

Dignomia alveata Hall

Craniella hamiltoniae Hall

Crania crenistriata Hall

Pholidops hamiltoniae Hall.....c

P. oblata Hall

Rhipidomella penelope Hall

R. vanuxemi Hall.....c

Orthotheses pandora Billings

O. arctostriatus Hall

Stropheodonta concava Hall

S. demissa Conrad.....tr

S. inequistriata Conrad

S. junia Hall

Pholidostrophia nacreata Hall

Chonetes aurora Hall

C. coronatus Conrad.....c

C. deflectus Hall.....c

C. lepidus Hall.....c

C. scitulus Hall.....c

Spirifer granulatus Conrad

S. marcyi Hall

S. audaculus Conrad

<i>S. tullius</i> Hall.....c	<i>C. dotis</i> Hall
<i>S. eatoni</i> Hall	<i>C. sappho</i> Hall
<i>Cyrtina hamiltonensis</i> Hall	<i>Cryptonella rectistrotris</i> Hall
<i>Ambocoella umbonata</i> Conrad....cc	<i>Eunella lincklaeni</i> Hall
<i>Nucleospira concinna</i> Hall.....c	<i>Tropidoleptus carinatus</i> Conrad
<i>Trematospira hirsuta</i> Hall	
<i>Meristella haskinsi</i> Hall	<i>Crinoids</i>
<i>Athyris spiriferoides</i> Eaton.....cc	<i>Nucleocrinus lucina</i> Hall
<i>Atrypa reticularis</i> Linné.....cc	<i>Forbesiocrinus lobatus</i> Hall
<i>A. spinosa</i> Hall.....c	<i>Calceocrinus clarus</i> Hall
<i>Camartoechia congregata</i> Conrad	<i>Platycrinus eboraceus</i> Hall

The contrasts in the faunas of these upper and lower beds are not deep seated. There is in the former as a most striking feature the profuse development of the crinoids associated with an almost equal profusion of *Phacops rana*, *Diaphorostoma lineatum* and *Pentamerella pavilionensis* with *Productella papulata*; in the upper beds lamellibranch species such as *Orthonota undulata*, *parvula*, *carinata*, *Phthonia nodocostata*, *Pholadella radiata* and specially *Tellinopsis submarginata* which are rare or absent below. There are also here thin beds wholly composed of *Ambocoella umbonata* but on the whole the distribution of the fauna throughout the Moscow shales is quite uniform.

The Moscow shales are exposed in detail in the ravine at Tichenor point where the succession from the bottom up is essentially as follows:

At the base the uppermost beds of the Canandaigua shales with *Eridophyllum archiaci*, *Heliophyllum* and other cyathophylloids in abundance.

Tichenor limestone

1 Blue calcareous shale with crinoids, *Pentamerella pavilionensis*, *Diaphorostoma lineatum*, *Phacops rana*, 2 feet, passing into a thin limestone 8 inches

2 Bluish shale with *Tropidoleptus carinatus*, 30 feet

3 Menteth limestone, 1 to 1½ feet

4 Bluish shale with *Tropidoleptus carinatus*

5 Olive shales with *Cryphaeus boothi*

6 Arenaceous shale with *Homalonotus dekayi*, *Orthonota*, abounding in grotesque calcareous concretions and passing into a thin limestone above, 12 feet

7 Olive shale

8 Very soft light gray shales with *Ambocoelia*, *Chonetes*, *Athyris* and *Phacops* in distant thin layers

9 Olive shale

Tully pyrite

Genesee shale

Tully limestone and pyrite

What little Tully limestone is here represented carries the indicial species *Hypothyris cuboides* Sowerby (sp.) identified originally by Conrad with Sowerby's *Rhynchonella cuboides* and subsequently described by Hall as *R. venustula*.

The species *R. cuboides* was long ago referred by King to the genus *Hypothyris*. This world-wide species is here a newcomer into the Devonian faunas and is associated throughout the exposures of the Tully with an assemblage essentially consisting of Hamilton species, though slight variations from Hamilton types are indicated and there are a few additional species present like the very characteristic trilobite *Bronteus tullius* Hall & Clarke. For at least a half century *Hypothyris cuboides* has been recognized as indicative of lowest upper Devonian age and the *Bronteus* associated with it is likewise of early Devonian type (*Thysanopeltis*). The fact that these species accompany an essentially unmodified fauna of earlier age does not argue that age for the limestone but serves to emphasize if anything the introduction of new types indicative of fundamental change.

The fauna of the pyrite layer is a parvifauna with affinities wholly or essentially with that of the Hamilton shales. It is in fact a series of forms which have as a whole suffered an arrest of development, and its species are immature stages of those preceding though they are actually in adult condition. The conditions of growth while this pyrite was being precipi-

tated, were so unfavorable that the organisms were able to advance but a little in the line of species development and yet they apparently acquired the power of reproduction and manifested themselves in these arrested conditions probably for several generations. These fossils were studied by the writer some years ago, and have been more exhaustively examined of late by Dr F. B. Loomis from material collected all along the line of outcrop of the layer.

The specimens are to be extracted from the rock only with great labor but it is to be expected that forms present at one place will appear at others and hence the entire list of the known species is here appended. It will be observed that the designations used in Dr Loomis's list here given indicate *mutations* only from the types of Hamilton species and not deep seated specific differences.

Crustaceans

Beyrichia dagon *Clarke*
Entomis prosepina *Loomis*
Cryphaeus boothi *var. calliteles*
Green

Cephalopods

Bactrites (sp.)? *mut. parvus Loomis*
B. (sp.) *mut. pygmaeus Loomis*
Orthoceras nuntium *Hall*
O. scintilla (?) *mut. mephisto Clarke*
O. subulatum *mut. pygmaeum*
Loomis
Tornoceras uniangulare *mut. astarte*
Clarke
T. uniangulare *Conrad*

Pteropods

Tentaculites bellulus? *mut. stebos*
Clarke
T. gracillistriatus *mut. asmodeus*
Clarke

Gastropods

Loxonema delphicola *mut. moloch*
Clarke
Pleurotomaria
P. itys *mut. pygmaea Loomis*
P. capillaria *mut. pygmaea Loomis*

Macrochilina hamiltoniae *mut. pyg-*
maea Loomis
M. hebe *mut. pygmaea Loomis*
Diaphorostoma lineatum *mut. bellal*
Clarke

Lamellibranchs

Conocardium eboraceum *mut. pyg-*
maeum Loomis
Buchiola retrostriata *mut. pygmaea*
Loomis
Grammysia constricta *mut. pygmaea*
Loomis
Paracyclas lirata *mut. pygmaea*
Loomis
Palaeonello constricta *mut. pygmaea*
Loomis
P. plana *mut. pygmaea Loomis*
Leda rostellata *mut. pygmaea*
Loomis
Nuculites oblongatus *mut. pygmaeus*
Loomis
N. triqueter *mut. pygmaeus Loomis*
Nucula varicosa *mut. pygmaea*
Loomis
N. corbuliformis *mut. pygmaea*
Loomis
N. lirata *mut. pygmaea Loomis*

<i>Brachiopods</i>	
<i>Trigleria lepida mut. pygmaea Loomis</i>	<i>Cyrtina hamiltonensis mut. pygmaea Loomis</i>
<i>Productella spinulicosta mut. pygmaea Loomis</i>	<i>Spirifer marcyi mut. pygmaeus Loomis</i>
<i>Strophalosia truncata mut. pygmaea Loomis</i>	<i>S. granulosus mut. pluto Clarke</i>
<i>Tropidoleptus carinatus mut. pygmaeus Loomis</i>	<i>S. tullius mut. belphegor Clarke</i>
<i>Ambocoella umbonata mut. pluto Loomis</i>	<i>S. medialis mut. pygmaeus Loomis</i>
<i>A. umbonata mut. pygmaea Loomis</i>	<i>S. mucronatus mut. hecate Clarke</i>
<i>Nucleospira concinna mut. pygmaea Loomis</i>	<i>S. fimbriatus mut. pygmaeus Loomis</i>
	<i>S. fimbriatus mut. simplicissimus Loomis</i>
	Crinoid stems
	<i>Pentremites leda Hall</i>

Genesee shale

This shale carries only a sparse fauna and its fossils are not well preserved. In the densely black layers there is rarely anything to be obtained, but lignites sometimes of considerable length, occasionally *Lepidodendron* and conodont teeth have also been found herein.

The less bituminous shales contain:

<i>Pleurotomaria rugulata Hall</i>	<i>Liorhynchus quadricostatus Hall</i>
<i>Styliolina fissurella Hall</i>	<i>Probeloceras lutheri Clarke (occasionally)</i>
<i>Pterochaenia fragilis Hall</i>	<i>Bactrites aciculum Hall</i>
<i>Lingula spatulata Hall</i>	
<i>Orbiculoidea lodensis Hall</i>	

Genundewa limestone

The fauna here appearing is, as we have explained on previous occasions, the first appearance in this district of the Portage or Naples fauna of the beds overlying. It is thus a prenuncial fauna announcing the invasion and occupancy of the field by a congeries of species not before known in New York. It is evident that this fauna came in from the west and covered for a short time only, the whole area from here westward to Lake Erie. We have shown elsewhere the probability that the rock itself, which is largely composed of the pteropod *Styliolina*, represents a deep water deposit of pteropod ooze and its associated organisms are also those of deep water habit. The fauna and flora of this limestone are as follows and in this list the

names in roman are of species reappearing in the higher faunas (Cashaqua); those in antique not occurring elsewhere.

Dinichthys newberryi Clarke
Echinocaris? longicauda Hall
Spathiocaris emersoni Clarke
Cardiocaris
Manticoceras pattersoni Hall var.
 styliophilum Clarke
M. contractum Clarke
M. fasciculatum Clarke
M. nodifer Clarke
Gephyroceras genundewa Clarke
Tornoceras uniangulare Conrad var.
 compressum Clarke
Orthoceras atreus Hall
Styliolina fissurella Hall
Tentaculites gracilistriatus Hall
Pleurotomaria genundewa Clarke
Bellerophon koeneni Clarke
B. denckmanni Clarke
Phragmostoma natator Hall
P. incisum Clarke
Loxonema noe Clarke
Macrochilina pygmaea Clarke
M. seneca Clarke

Diaphorostoma pugnus Clarke
Protocalyptraea styliophila Clarke
Lunulicardium hemicardioides Clarke
L. encrinurum Clarke
Pterochaenia fragilis Hall
P. sinuosa Clarke
Honeoyea styliophila Clarke
H. simplex Clarke
Ontaria suborbicularis Hall
Buchiola retrostriata v. Buch
B. livoniae Clarke
B. scabrosa Clarke
Paracardium doris Hall
P. delicatulum Clarke
Lingula spatulata Vanuxem
Lingulipora williamsana Girty
Aulopora annectens Clarke
Cordaoxylon clarki Dawson
Cladoxylon mirabile Unger
Cyclostigma affine Dawson
Lepidodendron gaspianum Dawson
L. primaevum Rogers

Taken as a whole the assemblage is rich and interesting and there are not more favorable opportunities for its examination than are afforded on Canandaigua lake. Specially noteworthy are the remains of plants of genera and species which have been found elsewhere only in corresponding horizons of Europe.

West River shale

In these beds we find a return of the shale fauna beneath (Genesee) with a few additional species. The distinctive characters of the division are essentially lithologic. Its fossils are:

Bactrites aciculum Hall (?)
Gephyroceras sp?
Pleurotomaria rugulata Hall
Buchiola retrostriata v. Buch
Paneka sp.

Pterochaenia fragilis Hall.....c
Lunulicardium curtum Hall
Lingula spatulata Vanuxem
Oriculoidea lodensis Vanuxem

Embedded in these shales not far above the Genundewa limestone is a thin and, over the region of this map, continuous limestone which is a mass of the crinoid *Melocrinus*

clarkei Hall. Over this surface for a brief period flourished a plantation of these crinoids and their substance has largely contributed to the lime content of the rock containing them.

Standish shales and flags

Fauna very sparse and chiefly that of the beds below.

Bactrites aciculum Hall?
Gephyroceras sp.
Pleurotomaria cognata Clarke

Pterochaenia fragilis Hall
Ontaria suborbicularis Hall

Middlesex shale

These densely bituminous deposits, similar in all respects to the Genesee shale bear only the most meager evidences of organic life. Indeterminable plant remains occasionally appear and with them are:

Conodonts
Sandbergeroceras syngonum Clarke

Ontaria suborbicularis Hall

The affinity of the fauna with that of the Cashagua shales is herein evident.

Cashagua shale

In these soft shale beds, with their accompanying flags and sands, the peculiar western Portage fauna attains its culmination. This interesting congeries of fossils has been termed the *Naples fauna* for it is here that it attains its best development. The term has been employed because of the indefiniteness of the term Portage as applied to the fauna, for the faunas existing in Portage time are known to differ highly according to their geographic location; brackish in eastern New York (Oneonta), a profuse brachiopod fauna in central New York (Ithaca) and in western New York a fauna essentially devoid of brachiopods but characterized by its abundance of cephalopods and lamelli-branches. In our latest studies of this fauna in its extent throughout western New York it has become evident that, in this western Portage province covering the field occupied by the fauna from Cayuga lake west to Lake Erie, the Genesee province as it has been designated, there are actually two subprov-

inces, an eastern (Naples subprovince) into which only the advance guard penetrated on its invasion from the west, and a western or Chautauqua subprovince. These two subfaunas of the Genesee provinces are knit together by unity of generic and to some extent of specific characters, but differ more in respect to predominant species.

We have then in the rocks before us the typical development of the fauna of this Naples subprovince or the Naples fauna in its proper sense.

The species are:

Crustaceans

Eleutherocaris whitfieldi Clarke
Stylonurus? wrightianus Dawson
Spathlocaris emersoni Clarke
Dipterocaris

Cephalopods

Manticoceras pattersoni Hall
M. apprimatum Clarke
M. tardum Clarke
M. accelerans Clarke
M. vagans Clarke
Proboloceras lutheri Clarke
P.? naplesense Clarke
Beloceras iynx Clarke
Tornoceras uniangulare Conrad
T. uniangulare var. *obesum* Clarke
Cyrtoclymenia neapolitana Clarke
Bactrites gracilior Clarke
B. aciculum Hall
Orthoceras pacator Hall
O. ontario Clarke
O. filosum Clarke

Pteropods

Hyolithus neapolis Clarke
Tentaculites gracilistriatus Hall
T. tenuicinctus Roemer
Styliolina fissurella Hall
Protopirialis minutissima Clarke

Gastropods

Loxonema noe Clarke
Macrochilina pygmaea Clarke
Palaeotrochus praecursor Clarke
Diaphorostoma rotundatum Clarke

Pleurotomaria cognata Clarke
P. ciliata Clarke
Protocalyptraea marshalli Clarke
Phragmostoma natator Hall
P. incisum Clarke
P. cf. triliratum Hall
Tropidocyclus hyalinus Clarke
Bellerophon koeneni Clarke

Lamellibranchs

Lunulicardium acutirostrum Hall
L. ornatum Hall
L. clymeniae Clarke
L. hemiardioides Clarke
L. velatum Clarke
L. finitimum Clarke
L. sodale Clarke
L. pilosum Clarke
L. parunculus Clarke
Pterochaenia fragilis Hall
P. fragilis var. *orbicularis* Clarke
P. perissa Clarke
Honeoyea erinacea Clarke
H. majora Clarke
Paraptyx ontario Clarke
Ontaria suborbicularis Hall
O. clarkei Beushausen
O. affiliata Clarke
O. halli Clarke
Buchiola retrostriata v. Buch
B. scabrosa Hall
B. conversa Hall
Paracardium doris Hall
Palaeoneilo petila Clarke
P. muricata Clarke

*Brachiopods**Productella speciosa Hall**Chonetes scitulus Hall**Lingula triquetra Clarke**L. ilgea Hall**Corals**Aulopora annectens Clarke**Crinoids**Melocrinus clarkel Hall**Plants**Cordaeoxylon clarkel Dawson**Lepidodendron gasplanum Dawson**L. primaevum Rogers*

In the midst of these Cashagua beds is the

Parrish limestone

which has frequently been referred to in our publications because, first, of its singular composition of greenish and reddish calcareous nodules, which are usually fused into a continuous mass and resemble the kramenzel so characteristic of some of the European Devonian beds of equivalent age, and again because the abundance of *Goniatites* which it contains chiefly of the species *Manticoceras pattersoni*, *Tornoceras uniangulare* and *Probeloceras lutheri*, together with *Orthoceras pacator*, some singular and undetermined fish remains and myriads of the pteropods *Styliolina* and *Protospiralis*. The rock is continuous nearly across the map and beyond it to the east.

Rhinestreet shale

In these recurrent beds of black shale the fauna is again very much curtailed. Only the following have been obtained from it:

*Polygnathus dubius Hinde**Prioniodus spicatus Hinde**P. erraticus Hinde**Palaeoniscus devonicus Clarke**Acanthodes pristis Clarke**Spathlocaris emersoni Clarke**Lunulicardium velatum Clarke**Pterochaenia fragilis Hall**Leptodomus multiplex Clarke***Hatch flags and shales**

The fossils in these arenaceous beds are all representatives of the Cashagua shale fauna but in very much decreased quantity. *Goniatites*, specially *Manticoceras pattersoni* and *Probeloceras lutheri* occur in the flagstones, also occasional specimens of *Lunulicardium ornatum* and *L.*

acutirostrum, *Honeoyea desmata* and *Buchiola retrostriata*, *Palaeotrochus praecursor* and *Bactrites*. In certain layers fragments of plants abound, chiefly of *Lepidodendron*.

Grimes sandstone

The Portage or Naples fauna has now disappeared except for a few straggling and modified representatives in the higher rocks and with the Grimes sandstone appears a well defined though somewhat sparse brachiopod fauna. We originally regarded this small fauna of the Grimes sandstone as a representative of the Chemung fauna but have subsequently expressed the view that it is rather the invading Ithaca fauna from the east. The distinction is a refined one; it would be extremely difficult to indicate at what time or horizon in the succession the term Chemung is to be applied to the homogeneous fauna occupying the field of central New York during the upper Devonian.

The fauna of the Grimes sandstone is as follows:

<i>Protonympha devonica</i> Clarke	<i>Leptostrophia mucronata</i> Vanuxem
<i>Palaeochaeta salicifolia</i> Clarke	<i>Chonetes lepidus</i> Hall
<i>Conularia cf. continens</i> Hall	<i>Liorhynchus mesacostalis</i> Hall
<i>Paracyclas</i> sp.	<i>L. globuliformis</i> Vanuxem
<i>Grammysia subarcuata</i> Hall	<i>Productella lachrymosa</i> Hall
<i>Aviculopecten cf. cancellatus</i> Hall	<i>Ambocoella umbonata</i> Conrad
<i>Sphenotus</i> sp.	<i>Atrypa spinosa</i> Hall
<i>Orbiculoidea</i>	<i>Paropsonema cryptophyllum</i> Clarke
<i>Schizophoria impressa</i> Hall	<i>Dictyospongia haplea</i> Hall & Clarke

West Hill flags and sandstone

The fauna of these beds is a continuation of the brachiopod fauna of the Grimes sandstone with some interesting additions. Nowhere are the fossils abundant and none are specially distinctive of the Chemung fauna so that we may regard these beds also as a continuation of the Ithaca invasion from the east. The fossils recorded are as follows:

<i>Manticoceras oxy</i> Clarke	<i>Grammysia elliptica</i> Hall
<i>Palaeotrochus praecursor</i> Clarke	<i>Pholadella cf. parallela</i> Hall
<i>Aviculopecten cancellatus</i> Hall	<i>Leptodesma robustum</i> Hall

<i>Stropheodonta cayuta</i> Hall	<i>Ambocoella umbonata</i> Conrad
<i>Leptostrophia perplana</i> Conrad var.	<i>Cyrtina hamiltonensis</i> Hall
<i>nervosa</i> Hall	<i>Liorhynchus mesacostalis</i> Hall
<i>Orthothetes chemungensis</i> Conrad	<i>Hydnoceras tuberosum</i> Conrad
<i>Productella lachrymosa</i> Hall	<i>H. variabile</i> Hall & Clarke
<i>Spirifer mucronatus</i> Conrad mut.	<i>H. legatum</i> Hall & Clarke
<i>S. mesacostalis</i> Hall	<i>Ceratodictya annulata</i> Hall
<i>Atrypa hystrix</i> Hall	<i>Hydriodictya cylinx</i> Hall & Clarke

High Point sandstone

The interesting fauna of the calcareous or firestone layer of this formation was studied some years ago by the writer and its species have not been increased by later observations. These occur in the beds on High point, Naples:

<i>Rhynchodus</i> sp.	<i>S. orestes</i> Hall & Whitfield
<i>Cladodus</i> sp.	<i>S. subattenuatus</i> Hall
<i>Pterinea</i> sp.	<i>S. mesacostalis</i> Hall
<i>Orthis infera</i> Calvin	<i>S. bimesialis</i> Hall
<i>Schizophoria iowensis</i> Hall	<i>Ambocoella umbonata</i> Conrad
<i>Stropheodonta cayuta</i> Hall	<i>Atrypa aspera</i> Hall
<i>S. arcuata</i> Hall	<i>A. hystrix</i> Hall
<i>S. canace</i> Hall & Whitfield	<i>A. reticularis</i> Linné
<i>S. variabilis</i> Calvin	<i>Camarotoechia contracta</i> Hall
<i>S. exilis</i> Calvin	<i>Hypothyris pugnus</i> Martin
<i>Strophonella reversa</i> Whitfield(?)	<i>Fistulipora occidens</i> Hall & Whitfield
<i>Orthothetes chemungensis</i> Hall	<i>Polypora</i> sp.
<i>Chonetes setiger</i> Hall	<i>Fenestella</i> sp.
<i>Productella speciosa</i> Hall	<i>Zaphrentis</i> sp.
<i>P. dissimilis</i> Hall	<i>Receptaculites</i> sp.
<i>Spirifer disjunctus</i> Sowerby	<i>Dadoxylon clarkel</i> Dawson

In this unusual congeries we find the earliest appearance of *Spirifer disjunctus*, which may be taken as indicating the advent of the true Chemung fauna. It is also important to note the very marked representation of species which were originally described from the upper Devonian of Iowa and have been observed nowhere else in the Appalachian region except spasmodically.

Exact correlation of the stages of the Iowan Devonian with that of New York is not practicable as the Silurian continental barrier between was the cause of great differences in sedimentation and fauna on its east and west sides, but this invading western fauna intercalated in the normal Chemung fauna of

this district may be regarded as an indication of the fact that the continental barrier was temporarily down and the western fauna migrated to the east.

Prattsburg sandstone

In these beds the fauna, which is fairly profuse in certain layers, does not materially differ from that of the West Hill beds. The Iowan species occurring in the High Point fauna are not present or if so are of extremely rare occurrence and certain species are abundant such as

<i>Spirifer mesastrialis</i> Hall	<i>Atrypa hystrix</i> Hall
<i>S. mucronatus</i> Conrad var. <i>posterus</i>	<i>A. reticularis</i> Linné
Hall & Clarke	<i>Stropheodonta cayuta</i> Hall

In certain of the beds from the upper part of the division occurs the trilobite *Bronteus senescens* Clarke, which has also been found as far south as Avoca, Steuben co. in the continuation of the same formation. Associated with it is the spiny crinoid *Hystericrinus depressus* Wachsmuth & Springer which is known only from these beds.

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New York State Museum

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- Pa3 (42)** Ruedemann, Rudolf. Hudson River Beds near Albany and their Taxonomic Equivalents. 114p. 2pl. map. Ap. 1901. 25c.
- Pa4 (45)** Grabau, A. W. Geology and Paleontology of Niagara Falls and Vicinity. 286p. il. 18pl. map. Ap. 1901. 65c; cloth 90c.

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Contents: Ruedemann, Rudolf. Trenton Conglomerate of Rysedorph Hill.
 Clarke, J. M. Limestones of Central and Western New York Interbedded with Bituminous Shales of the Marcellus Stage.
 Wood, Elvira. Marcellus Limestones of Lancaster, Erie Co. N. Y.
 Clarke, J. M. New Agelacrinites.
 —Value of *Amnigenia* as an Indicator of Fresh-water Deposits during the Devonian of New York, Ireland and the Rhineland.
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- Pa10** — Report of the State Paleontologist 1903. *In press.*
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- 3 Clarke, J: M. The Oriskany Fauna of Becraft Mountain, Columbia Co. N. Y. 128p. 9pl. Oct. 1900. 80c.

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4 Peck, C. H. N. Y. Edible Fungi, 1895-99. 106p. 25pl. Nov. 1900. 75c.
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5 Clarke, J. M. & Ruedemann, Rudolf. Guelph Formation and Fauna of New York State. 196p. 21pl. July 1903. \$1.50, cloth.

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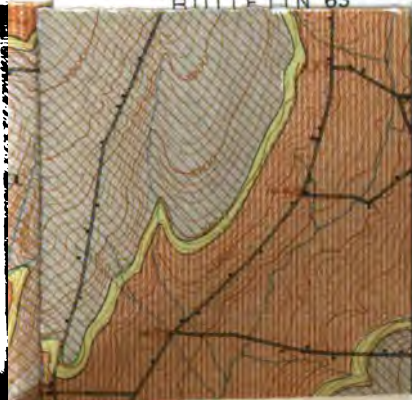
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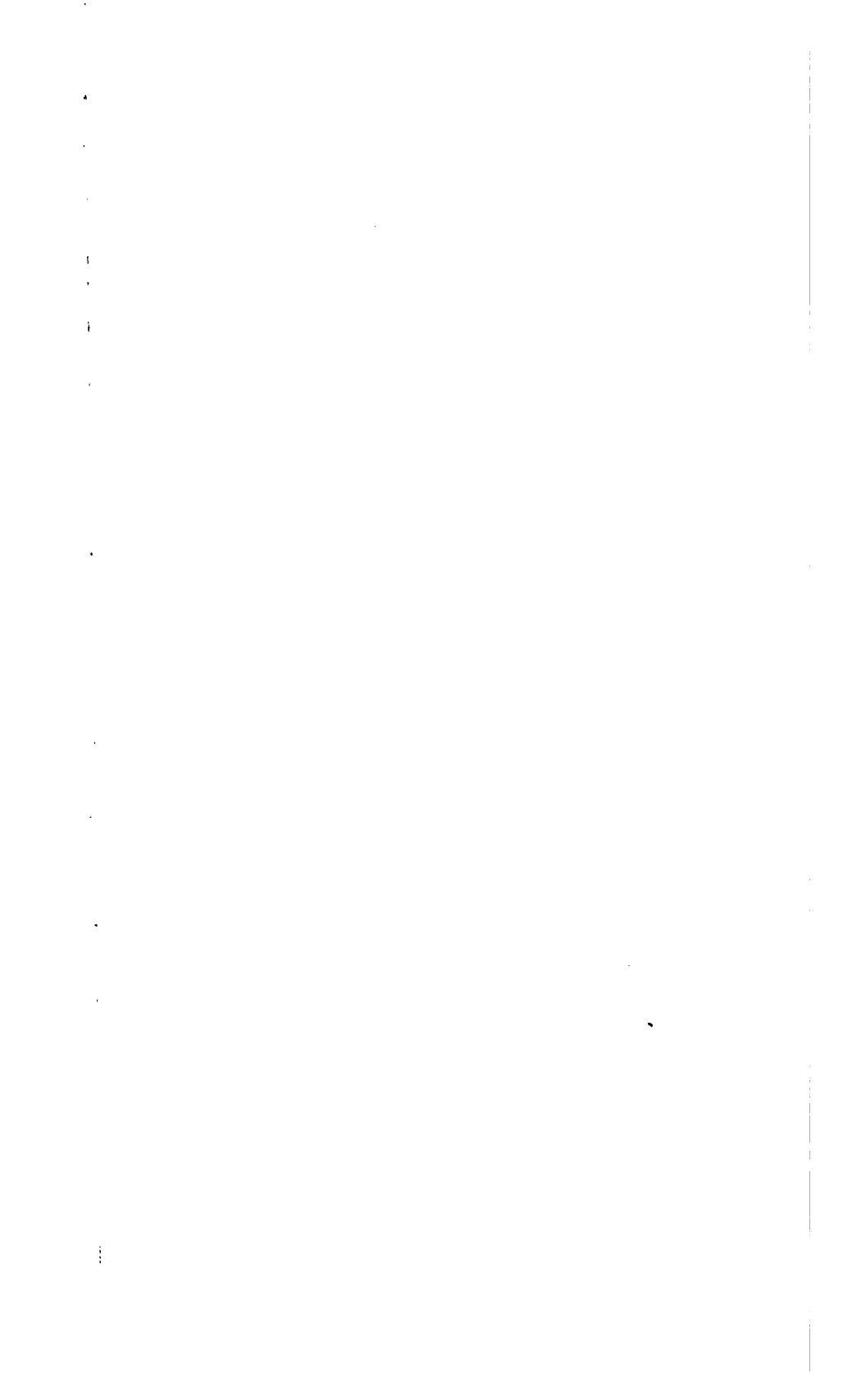
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**Catalogue of the Cabinet of Natural History of the State of New York and
 of the Historical and Antiquarian Collection annexed thereto.** 242p. O.
 1853.
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Maps. Merrill, F: J. H. Economic and Geologic Map of the State of New
 York; issued as part of Museum bulletin 15 and the 48th Museum Report,
 v. 1. 59x67 cm. 1894. Scale 14 miles to 1 inch. *Separate edition out of
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 — Geologic Map of New York. 1901. Scale 5 miles to 1 inch. *In atlas
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 The lower Hudson sheet, geologically colored, comprises Rockland, Orange, Dutchess, Putnam,
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 Ulster and Suffolk counties; also northeastern New Jersey and part of western Connecticut.
 — Map of New York showing the Surface Configuration and Water
 Sheds. 1901. Scale 12 miles to 1 inch. 15c.
 Clarke, J: M. & Luther, D. D. Geologic Map of Canandaigua and Naples
 Quadrangles. 1904. 20c.
 Issued as part of Paleontology 7.



Stratigraphic and paleontologic map

by John M. Clarke and D. D. Luther





New York State Museum

The New York State Museum as at present organized is the outgrowth of the Natural History Survey of the State commenced in 1836. This was established at the expressed wish of the people to have some definite and positive knowledge of the mineral resources and of the vegetable and animal forms of the State. This wish was stated in memorials presented to the Legislature in 1834 by the Albany Institute and in 1835 by the American Institute of New York city and as a result of these and other influences the Legislature of 1835 passed a resolution requesting the secretary of state to report to that body a plan for "a complete geological survey of the State, which shall furnish a scientific and perfect account of its rocks, soils and materials and of their localities; a list of its mineralogical, botanical and zoological productions and provide for procuring and preserving specimens of the same; etc."

Pursuant to this request, Hon. John A. Dix, then secretary of state, presented to the Legislature of 1836 a report proposing a plan for a complete geologic, botanic and zoologic survey of the State. This report was adopted by the Legislature then in session and the governor was authorized to employ competent persons to carry out the plan which was at once put into effect.

The scientific staff of the Natural History Survey of 1836 consisted of John Torrey, botanist; James E. DeKay, zoologist; Lewis C. Beck, mineralogist; W. W. Mather, Ebenezer Emmons, Lardner Vanuxem and Timothy A. Conrad, geologists. In 1837 Mr Conrad was made paleontologist and James Hall, who had been an assistant to Professor Emmons, was appointed geologist to succeed Mr Vanuxem, who then took charge of Mr Conrad's geological district.

The heads of the several departments reported annually to the governor the results of their investigations, and these constituted the annual octavo reports which were published from 1837 to 1841. The final reports were published in quarto form, beginning at the close of the field work in 1841, and 3000 sets have been distributed, comprising four volumes of geology, one of mineralogy, two of botany, five of zoology, five of agriculture, and eight of paleontology.

JUN 21 1933

11,983

Published monthly by the

University of the State of New York

BULLETIN 283

MAY 1908

New York State Museum

FREDERICK J. H. MERRILL Director

EPHRAIM PORTER FELT State Entomologist

Bulletin 64

ENTOMOLCGY 17

18th Report of the State Entomologist

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1902

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ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

University of the State of New York

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University of the State of New York

New York State Museum

FREDERICK J. H. MERRILL Director

EPHRAIM PORTER FELT State Entomologist

Bulletin 64

ENTOMOLOGY 17

18th REPORT OF THE STATE ENTOMOLOGIST

1902

To the Regents of the University of the State of New York

I have the honor of presenting herewith my report on the injurious and other insects in the State of New York for the year ending Oct. 15, 1902.

General entomologic features. The season of 1902 was comparatively poor for the development of many insects, and as a consequence relatively few species destructive to staple crops were brought to notice. The elm leaf beetle, *Galerucella luteola* Müll., has continued its ravages in the Hudson river valley, is gradually extending its range, and is worthy of particular mention because of its having become established in force at Schenectady and Saratoga Springs. The white marked tussock moth, *Notolophus leucostigma* Abb. & Sm., is a well known pest of city shade trees, and serious depredations by it have been recorded from time to time. Thousands of horse chestnuts in the vicinity of Buffalo were practically defoliated by this insect during the past season, and it is not improbable that the same would have been true of other cities in the western part of the State had it not been for persistent efforts to check the insect in earlier years. The fall webworm, *Hyphantria textor* Harris, is a common pest which is generally destructive to many trees. It was unusually abundant and injurious in the southern part of the State, particularly in Orange county, and also to a lesser extent in some of the western counties. The black banded Lecanium, *Lecanium nigrofasciatum*

Perg., is an insect which has attracted comparatively little attention in this State. It was noticed briefly in our preceding report, and during the past summer has become unusually abundant on many soft maples in the city of Albany. The birch leaf *Bucculatrix*, *Bucculatrix canadensisella* Chamb., was extremely abundant and injurious over an extended area in 1901. and during the present year has been almost as destructive in portions of the same area. The operations of several bark borers were brought to notice in 1901, and it is gratifying to state that the injuries by these destructive little creatures appear to be lessening. An interesting insect bearing the common name of the carrot rust fly, *Psila rosae* Linn., was brought to our attention last December on account of its operations in celery at Broad-albin, Fulton co. This is believed to be the first instance of the insect being known to occur in the State.

Office work. It is very gratifying to note that the interest in the work of the office and the demands made on its staff have steadily increased. The determination of scale insects for the commissioner of agriculture, in connection with the nursery inspection work of his department, makes considerable inroads on our time. Most of this delicate and important work has devolved on the first assistant, Mr C. M. Walker. Many photographs of living insects or specimens of their work have been taken during the course of the year, and a number of lantern slides have been added to our collection, which has already been used to excellent advantage in illustrating popular lectures. The mailing list of the office has been largely increased during the past year, principally by paid subscriptions, showing that the public desires our publications and is willing to pay for them when the method of obtaining them is known. The correspondence has nearly doubled over that of the preceding year, as is evidenced by the following figures: 1559 letters, 1811 postals, 1842 circular letters and 2369 packages were sent through the mail during the past year.

The resignation of the first assistant, Miss M. F. Boynton, made a vacancy to which Mr C. M. Walker, then second assistant, was promoted. Mr Douglas B. Young, of Ilion, having successfully passed the civil service examination, was appointed second assistant. These changes in the office force can not be made

without interrupting the continuity of the work and in a measure marring its value. It is to be hoped that in time the salaries for assistants may be large enough to induce men to remain for a series of years.

Special investigations. The lines of work prosecuted in 1900 and 1901 have been continued and other investigations taken up.

The grapevine root worm, *Fidia viticida* Walsh, had caused so much injury in the Chautauqua grape belt that a special investigation of the pest was undertaken last spring and is still in progress.

The series of experiments with insecticides for the control of the San José scale have been carried on in the same orchard as during the last two years, and the earlier results have been largely confirmed. These have also been tested by experiments in other sections of the State. Further details of this work will be found on subsequent pages. A Chinese ladybug, *Chilocorus similis* Rossi, has been established in our experimental orchard in the hopes that it will prove a valuable ally in controlling this pest.

The study of forest and shade tree insects has been continued; and the observations of earlier years, together with those of the past season, are now ready for publication, and will appear in an extensive memoir.

The investigations on aquatic insects, commenced in 1900 by Dr J. G. Needham at Saranac Inn, and continued last year at Ithaca, were further prosecuted during the past season. The work of 1902 has been confined largely to a study of the stone flies, Perlidae, and a family of small flies, Chironomidae, a group which is very important so far as fish food is concerned, and which was also reported on to some extent by Mr O. A. Johannsen in Dr Needham's second report.

The entomologist has undertaken an investigation of mosquitos of the State, and considerable information has already been secured. Lack of funds and pressing duties have prevented bringing the work to a successful conclusion.

Publications. The principal publications of the entomologist, to the number of 64, are listed under the usual head. The more important of those issued during the past year are the following: *Scale Insects of Importance and a List of Species in New York*

State (Museum bulletin 46), *Aquatic Insects of the Adirondacks* (Museum bulletin 47), *17th Report of the State Entomologist* (Museum bulletin 53), and the *Elm leaf Beetle in New York State* (Museum bulletin 57). The former two, as stated in our previous report, were practically completed at the end of last year. The bulletin on the elm leaf beetle is an extended and revised edition of Museum bulletin 20, and was issued on account of the great demand for information concerning this serious pest of our elms. In addition to the above, the entomologist contributed an important paper on *Aquatic Insects of the Saranac Region* in the sixth annual report of the Forest, Fish and Game Commission, and one on shade tree pests for the report of the Colorado State Board of Horticulture for 1901.

Other important publications which are either in the printer's hands or practically completed are as follows: *Aquatic Insects in New York State*, which is a second report by Dr Needham and his associates, and treats largely of the damsel flies, Odonata-Zygoptera, the insect food of the brook trout, certain aquatic beetles (Donacia), some midges (Chironomidae), a group of much importance as food for fishes, and the Neuropterous family, Sialidae; the bulletin on the grapevine root worm, comprising a detailed account of this very injurious species, with special reference to its control, a publication of 36 pages; a monograph of the genus Saperda, which includes some of our most destructive wood borers, has been prepared by the entomologist in association with Mr L. H. Joutel of New York, and will form a small bulletin of about 40 pages, illustrated by seven colored plates; and the memoir on insects injurious to forest and shade trees, an extensive publication illustrated by many half tone and 16 colored plates, treating specially of those forms which are destructive to shade trees.

Collections of insects. Large additions to the State collections have been made during the past season. The systematic collecting at Karner begun last year was continued throughout the present season, and many interesting forms infesting various forest trees were secured. My second assistant, Mr D. B. Young, spent 10 days collecting at Newport N. Y., where the fauna is exceptionally rich, but, owing to continued unfavorable weather, the results were not all that were expected. Considerable pro-

gress has been made in arranging the Lepidoptera, the work of Mr Walker; while Mr Young has given much attention to the Coleoptera, and this order will soon be in a very satisfactory condition. The collection prepared for exhibition at the Pan-American Exposition has been installed in the museum and is now accessible to the public. A number of additions have been made to it, and desirable specimens are being added as fast as secured. A special collection, illustrating the characteristics of some of our more important mosquitoes, has been put on exhibition.

New quarters. The past year is the first entire one in the present quarters; and the additional facilities afforded by them have proved of greatest value and permitted the undertaking of work which would have been impossible under earlier conditions. It was thought at the time the present quarters were assigned that there was ample space, but insects and examples of their work have accumulated so rapidly that a crowded condition is already beginning to prevail.

Voluntary observers. The work of the voluntary observers begun in 1899 has been continued, but, owing to the unusually cold, rainy season, there has been comparatively little to report. The observations made are published under the usual head [*see p. 144*].

Acknowledgments. The entomologist is under deep obligations to a number of professional workers. To Dr L. O. Howard, chief of the division of entomology of the United States Department of Agriculture, and his staff, special acknowledgments are due for the determination of a number of insects and for information supplied. Professor J. H. Comstock of Cornell University has kindly aided in prosecuting the work on aquatic insects during the past summer, and our thanks are due him for these services. It is a pleasure to acknowledge the continued support of the office by its many friends and to feel that our efforts have been so highly appreciated by those in authority.

Respectfully submitted

EPHRAIM PORTER FELT

*Office of the State Entomologist
Albany, Oct. 15, 1902*

State Entomologist

INJURIOUS INSECTS

Euproctis chrysorrhoea Linn.

BROWN TAIL MOTH

Ord. *Lepidoptera*: Fam. *Bombycidae*

Introduced or foreign insects have played a very important part in earlier years, and, if we may judge from recent developments, this leading role will be continued for some time. Our report for the year 1900 contains a summary notice of one of the most injurious foreign insects which have become established on our shores in recent years; and this occasion is taken advantage of to notice in a similar manner a more recently established species, which promises to be of considerable economic importance as a destroyer of fruit trees and also as a most serious annoyance to man in all localities where it becomes established in numbers. It is not often that an insect is destructive to vegetation and also markedly injurious to man, and yet this is true of the above named species. The hairs of the caterpillar of this species, coming in contact with the human flesh, produce "a fierce and enduring irritation," as characterized by Mr A. H. Kirkland; and so annoying and prevalent was this that the board of health of the city of Boston gave a public hearing on the subject in 1901.

Not in New York. This species does not occur in the State of New York; but, as both the male and female moths are provided with serviceable wings, and as they are readily carried by the winds and with household goods and probably other merchandise, it would not be surprising if the species became established in some locality in New York State in the near future. It was originally located at Somerville Mass., and in 1901 was known to have made its way nearly 30 miles west to Hudson Mass. This species, like some others, is readily controlled when present in small numbers; and, for this reason, we have deemed it advisable to illustrate the insect in color in its various stages, so that it may be readily recognized and promptly checked in any locality where it may obtain a foothold.

Distribution. Messrs Fernald and Kirkland state that the brown tail moth occurs in all parts of Europe, except the extreme north, and also in northwestern Africa and in Asia Minor.

Its presence in this country was first brought to the attention of Prof. C. H. Fernald in 1897, when it was learned that the species had become established in numbers in Cambridge and Somerville. During that year it was found that the pest occurred over the greater part of these two towns and Everett, in a small part of Medford near the Somerville line, and that there was a single colony in Malden. The following year a gale of wind occurred during the height of the flying season, and the moths were carried for a distance of 10 or 12 miles to the north and north-east, as stated by Professor Fernald. The rapidity with which the insect has extended its range is well illustrated by a table of the estimated area infested by the moth in the early years. This was prepared by Mr Kirkland and is as follows:

Area infested fall of	Square miles
1896.....	29
1897.....	158
1898.....	448
1899.....	928

It will be seen by the above that the insect is rapidly extending its range, and it is now known to occur at Kittery Me. and at Seabrook N. H.

Description. The male moths have a wing spread of about $1\frac{1}{4}$ inches, are pure white with a satiny luster on the fore wings and have a conspicuous reddish brown tuft at the tip of the abdomen [pl. 1, fig. 5, 6]. Sometimes there are a few black spots on the fore wings. The antennae are white and fringed with pale yellowish hairs.

The females have a wing spread of about $1\frac{3}{4}$ inches, are the same color as the males, except that they have no black spots on the wings, and the anal tuft is larger and lighter in color, while the antennae are shorter and with shorter fringes.

The eggs are laid in July in masses composed of 200 to 300 and placed usually on the underside of the leaves [pl. 1, fig. 1], where they are covered with brown hairs from the tip of the abdomen. They hatch in a short time, and the young feed during the rest of the season on the surface of the leaves, a few days only being required to skeletonize them. The caterpillars begin to make a nest in which they hibernate while still young. It is constructed on the twigs and is made by drawing together a few

leaves, lining them with silk, and inclosing them with a mass of silken threads. These tents [pl. 1, fig. 7] are so firmly secured to the twigs that they can not be removed without considerable force.

The young caterpillars emerge from their winter retreats before the leaves begin to appear, often attack swelling buds and complete their growth in the early part of June, when they transform to pupae. The full grown caterpillars [pl. 1, fig. 3] range from 1 inch to $1\frac{1}{4}$ inches in length. The pale brown head is mottled with dark brown and has reddish brown hairs scattered over its surface. The body is dark brown or black with numerous fine, dull orange or gray spots over the surface, which are most pronounced on the second, third and fourth segments. Long reddish brown, finely barbed hairs arise from all the tubercles, and white branching hairs from the upper side of the latter tubercles on segments 4 to 12 inclusive. These white hairs form elongated white spots along each side and are one of the most striking characteristics of this caterpillar. The subdorsal and lateral tubercles on segments 4 to 12 inclusive are covered with fine, short spines of uniform length. There is a bright red retractile tubercle on the top of the 10th, and also one on the 11th segment.

The pupae are $\frac{3}{4}$ inch in length, dark brown in color and with fine, yellowish brown hairs [pl. 1, fig. 4] scattered over the surface.

Habits of the caterpillars. The following account of the habits of these caterpillars is taken from a bulletin by Fernald and Kirkland, and is as follows:

The young caterpillars of the brown tail moth, after hibernating in the tents which they construct at the tip of the branches, emerge in the spring and feed downward towards the main branches and trunk, leaving the naked twigs bearing the gray tents at the ends, a conspicuous evidence of the presence of this insect. They eat the entire leaf except the midrib, and, in leaves having strong ribs, like those of the sycamore maple, all the larger ribs are left untouched. When the caterpillars are numerous they devour not only the buds, leaves and blossoms, but even the green fruit.

The caterpillars are quite gregarious up to the later stages of their growth, when they disperse to some extent; but when they occur only in moderate numbers, they retain their gregarious

habits to a greater degree than when they are very abundant, since in this case the supply of food is soon exhausted and they are forced to migrate. When these caterpillars molt, they gather in masses on the branches and cover themselves with a scanty mass of silk. When preparing to change to the pupal stage, several of the caterpillars spin up in a common cocoon within the leaves at the tip of the branches. When numerous, they frequently pupate in masses under fences and clapboards, or on the trunks and larger branches of the trees.

The webs of the brown tail moth should not be confounded with those of the tent caterpillar or the fall webworm. They may be distinguished from those of the tent caterpillar by being placed at the tips of the branches, while the tent caterpillar constructs its tent in a fork of the limbs. The latter insect rarely, if ever, attacks pear, which is a favorite food plant of the brown tail moth. The fall webworm, while often found on peartrees, spins a large open web at the ends of the branches and feeds within this web. This insect does not appear until after the brown tail moth has ceased to do damage.

Food plants. This species has been recorded on a considerable number of food plants, but, according to Professor Fernald, pear seems to be the favorite of this insect in the infested region, though winter webs have been found in addition on apple, quince, plum, cherry, peach, oak, maple, elm, rose and grape.

Irritation caused by the hairs. This has been referred to above; and, as there stated, is frequently very severe and annoying. Investigations by Mr F. J. Smith show that the trouble is a mechanical one, and is not, as at first was supposed, due to any poisonous irritant substance in the hairs. The nettling of the skin may be caused by contact with the caterpillars, both old or young, or the cocoons, though in the latter case contact is not necessary since hairs from them are blown about by the winds. Professor Fernald cites the statement of an English journal to the effect that travelers are often affected, when the wind blows strongly from infested hedges along the road.

Natural enemies. A number of parasites have been bred from the pupae in this country. Professor Fernald records the rearing of *Phaeogenes hebe* Cress., *Diglochis omnivora* Walk., *Euphorocera claripennis* Macq. and a large number of unnamed dipterous parasites. He states that the work of *Diglochis* is specially valuable and worthy of commen-

dation. He also records the destruction of the caterpillars by a soldier bug, *Podisus serieiventris* Uhl.; states that the Baltimore oriole, black-billed cuckoo, crow, bluebird and English sparrow have also been observed feeding on these insects, and quotes Mr Kirkland to the effect that the birds eat not only the moths, but their young, and that it was no uncommon sight at Somerville to see flocks of 20 or more sparrows collect the moths from a picket fence. In addition to the above mentioned birds, Mr E. H. Forbush has recorded the robin, bluejay, black and white warbler, the rose-breasted grosbeak, the chestnut-sided warbler, the scarlet tanager, redstart, chickadees, red-eyed vireos, the yellow-throated vireo and the male indigo bird as feeding on the caterpillars. The records given by Mr Forbush include the number of larvae eaten by each bird and the time occupied. None ate less than nine, and one as many as 57 caterpillars, the latter operation occupying 20 minutes. These observations show that our native birds will undoubtedly prove to be very efficient aids in checking this pest. Professor Fernald has also recorded bats as feeding on the moths at night, and he states that toads devour the caterpillars during the early summer and the moths later in the season.

Remedial measures. The conspicuous hibernating nests [pl. 1, fig. 7] of this species are easily detected at any time when the foliage is off the trees, and one of the most effective methods of checking this pest is to cut them off and burn them. This can be very easily done with the aid of long handled pruning shears. The insect is also readily controlled with arsenical poisons; and Professor Fernald reports experiments in spraying with arsenate of lead, in which 1 pound to 150 gallons, killed 50% of the caterpillars in four days, 90% in seven days and all in 13 days. Treatment with the same insecticide, 2 pounds to 150 gallons, gave similar results, and, when 5 pounds were used to 150 gallons, 80% were dead within four days and all in nine days. The use of 10 pounds to 150 gallons resulted in the destruction of all the caterpillars in six days.

Spraying with paris green, 1 pound to 150 gallons, killed 4% in four days, 70% in six days and 90% in nine days, all being dead in 12 days.

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Psila rosae Fabr.

CARROT RUST FLY

Ord. *Diptera*: Fam. *Psilidae*

Celery roots infested with a dipterous larva, which subsequently proved to be this species, were received Dec. 30, 1901, from James Granger, Broadalbin, who states that the attack was confined to the roots and crown, never interfering with the stalk. Several larvae were taken from one root, and their burrows, about $\frac{1}{8}$ inch in diameter, were lined with reddish particles of comminuted tissue. The galleries were found in the roots near the crown and also in the crown and frequently ran obliquely for a distance partly around the root or crown, as the case may be, and in some instances they were near the center of the infested plant. The attack was a serious one, as is evidenced by the ruining of about 6000 plants. Traces of the insect were found all over a field containing some 60,000 plants.

Introduction and injuries in America. This is a European insect, which prior to 1885 was not known to occur in this country. It was then reared by Dr Fletcher from carrots purchased in the market at Ottawa, where the following year he found young carrot plants in a garden badly attacked. The same year a great deal of damage was done, particularly to stored roots

during the winter. Mr F. B. Caulfield, an entomologist in Montreal, reported that in February 1887 nearly all the carrots he had seen exposed for sale were more or less attacked. Early carrots were badly injured at Nepean Ont., nearly every root showing signs of the insect's presence, and two thirds of the crop was seriously injured, as stated by Dr Fletcher in his report for 1887. The species was reported in 1897 as occasioning considerable complaint during the previous 10 or 12 years, chiefly in the province of New Brunswick, but also in Ontario and Quebec. The attack was described as being a serious one, rendering useless roots stored for table use. A party at Rothsay, Kings co. N. B. noticed in 1895 that late sown carrots were less injured than those planted earlier, and since that time late sowing has been recommended and proved of considerable value, according to Dr Fletcher's report for 1897. Injury has also been recorded at Upper Sackville, Brookville and Clifton N. B., it being noticed in the first named locality in 1894 and 1895 and at Brookville during the latter year and at Clifton for several years. Few carrots had been grown in the last named locality during late years, on account of this pest, as stated by Dr Fletcher in his report for 1897. The following year he records specific injury to carrots at Noulton and Ste Marie Que.

The above summary of the insect's occurrence in this country, as well as some of the following matter, has been taken from Mr F. H. Chittenden's account in Bulletin 33, new series, of the division of entomology of United States Department of Agriculture.

Distribution. This species is a well known pest in England and Germany and probably occurs elsewhere on the continent of Europe. It was originally described from Kilia, Bessarabia. Just when it was first introduced in this country does not appear to have been recorded. Its ravages were not apparent however till 1894, and up to last year the insect appears to have been confined to Canada, though there is in the National Museum a single specimen received from Mrs A. T. Slosson, labeled Franconia N. H. There appears to be no record other than Mr Chittenden's, which relates to the same outbreak, of the species having been found previously in New York State, and celery is a new food plant for the pest. This divergence in food habits is not sur-

prising, since it frequently happens that a species introduced into a new country forms new habits and depredates on other plants. Mr Chittenden expresses the opinion that the insect has probably been established in Canada for at least 18 years and adds that it will probably not extend farther south than the upper Austral life zone.

Life history. The life history of this species does not appear to have been worked out. The insect undoubtedly passes the winter in puparia and, according to Mr Chittenden, possibly as larvae. Since the larvae work on stored roots, the flies may develop in winter, as occurred at Washington and also in our own breeding cages. This permits great irregularity in development and makes it impossible to accurately forecast the habits of the insect in the field. The flies probably develop rather early in the season and attack young carrots, which turn a rusty red color. An examination will show that the roots have been disfigured with rusty patches, specially toward the tip. Both the flies and maggots are found throughout the warmer months, but the latter desert the roots and pupate in the earth. It is very probable that the last generation in a season descends much deeper than the earlier ones. The life cycle is completed in three or four weeks, as stated by Curtis, and no one appears to have determined the number of generations which may be produced. Mr Chittenden is of the opinion that there are at least two and probably more, and we are inclined to think his estimate is a conservative one. Miss Ormerod states that the fly goes into the ground for oviposition wherever it can find a crack or other opening about the roots, and that the maggots, after hatching, work their way into the roots and even when quite small destroy the entire lower portion.

Description. The adult or parent fly is quite minute, measuring only about $\frac{1}{4}$ inch in length and with a wing expanse of little more than $\frac{3}{16}$ inch. The color is dark green, by some authors given as black, and the insect is rather sparsely clothed with yellow hairs. The head and legs are pale yellow and the eyes black.

The maggot or larva is pale yellowish white when half grown and when full grown presents a general resemblance to that of the cheese maggot, to which the species is somewhat closely related.

It is then much darker in color, being rather dark brown with well marked segments, a minute head and the posterior extremity truncate. The general appearance of the larva is shown at figure 1.

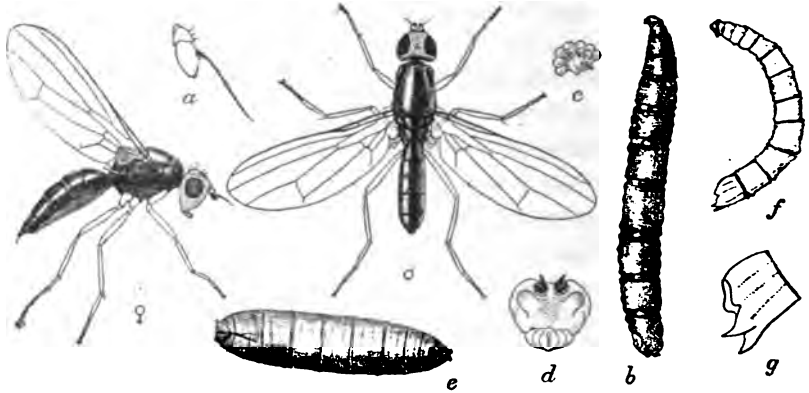


FIG. 1 *Peltia rosae*: ♂ male fly, ♀ female fly: lateral view; a, antenna of male; b, full grown larva, lateral view; c, spiracles of same; d, anal extremity from the end; e, puparium; f, young larva; g, anal segment from side — flies, young and mature larva, and puparium, eight times natural size; other portions more enlarged. (After Chittenden, U. S. Dep't Agric. div. ent. Bul. 83, n. s. 1902)

Natural enemies. Very little has been recorded concerning the natural enemies of this species. Curtis found a small four winged fly which he described as *Alysia apii* and presumed was a natural enemy of this pest.

Remedial measures. This species, like others which exist under ground, is difficult to control with insecticides, and our principal dependence must therefore be based on cultural methods which may serve to avert attack.

The standard kerosene emulsion, 1 part to 10 of water, may be sprayed along carrot rows with knapsack or other sprayer. Sand, land plaster or ashes, with which kerosene has been mixed at the rate of $\frac{1}{2}$ pint to 3 gallons, may be sprinkled along the rows. These, with the exception of crude carbolic acid, a pint in 5 gallons, are about the only substances which have given good results. Dr Fletcher states that in Canada one or the other of these applications should be made weekly during June from the time the roots begin to form, and particularly after the rows have been thinned.

Late sowing has also been practised to great advantage, and a number of persons have found it to be of considerable value.

Rotation of crops. This may be practised with comparatively little expense, and is very successful in checking pests of this character. The fields planted in successive years should be as far from others as practicable. Some of the most serious injuries have occurred on pieces where carrots have been grown year after year. Now that we know this insect breeds in celery as well as carrots, one should not follow the other. Clean cultivation should also be practised in order to destroy all remnants of either celery or carrots in which the insects may pass the winter.

Destruction of the insect in stored roots. The breeding of this species in stored roots suggests the advisability of destroying the larvae which forsake the roots and enter the soil to undergo their transformations, or the puparia. Where roots are packed in earth, the surrounding soil may be either buried deeply or spread out in thin layers where it will be exposed to the elements, or thrown into pools where it may be frozen, or exposed to heat or steam or any agency which will result in the destruction of the contained insects. These roots are also frequently stored in bins in cellars; and such inclosures, if nothing else be done, should have all openings protected by a fine wire screen, so that the adult insects can not escape to the open the following spring. It might be possible to fumigate such a cellar with carbon bisulfid or sulfur or hydrocyanic gas before opening it in the spring.

Fall cultivation. Mr Chittenden has recommended the light raking or cultivating of celery or carrot beds in the fall, so that the larvae or puparia may be destroyed by the frost. He also thinks that plowing early the following spring before the flies have had time to escape would result in destroying many of the insects.

NOTES FOR THE YEAR

The following brief account includes some of the more important insects brought to notice during 1902.

Special attention, as in the case of last year, has been given to forest and shade tree insects throughout the summer. Systematic collecting was continued at Karner, where there is an admirable growth of scrub oaks and small pines, and much valuable material secured, which will be reported on in another publication. The warm, sandy soil of Karner seems specially adapted for certain heat-loving insects; and last year we

were surprised at finding the large cicada-killer, *Sphecius speciosus* Drury, comparatively abundant.

Another southern species, *Polyphylla variolosa* Hentz, was found at Karner Aug. 4, 1902, by Mr Young. The specimen was dead, but in a good state of preservation, and was evidently native. This southern species has not, to our knowledge, been taken so far north in this state at least.

Another interesting capture was that of *Cincindela punctulata* Fabr, which was taken at Albany Aug. 4, 1902, by Mr Young.

The notes regarding the various species mentioned below have been grouped under convenient heads, as last year, so they may be of greater service to parties interested in the more practical aspect of this work.

Fruit tree pests

Appletree tent caterpillar, *Clisiocampa americana* Fabr. This species is annually more or less destructive in various sections of the State, and the season of 1902 has proved no exception to the general rule. Accounts of some severe injuries have been received from certain counties, and in others relatively little damage has been inflicted. Something out of the ordinary and worthy of record is reported by Mr J. F. Rose, of South Byron, who states that this common pest was extremely rare in Genesee county, and attributes the scarcity to the large number of wayside bushes killed by mice, which girdled them while protected by the heavy snows of last winter. The injury by mice was so extensive that almost every bush for considerable distances along the highway was killed in this manner; and the young caterpillars hatching from eggs on these bushes perished from lack of food.

Forest tent caterpillar, *Clisiocampa disstria* Hübner. The severe injuries to forest trees by this pest during the past four or five years have been gradually decreasing, and areas where the insect has been extremely destructive in earlier seasons have suffered comparatively little. The zone of greatest damage is apparently moving eastward in the case of Greene county. Some damage was inflicted on maple and orchard trees in eastern Greene and western Columbia counties during the past season, but the depredations generally speaking were not nearly so

severe as last year. The hard maples at Annandale, Dutchess co., suffered to some extent from the work of this pest; and, while the species was reported as being rare at Newport, Herkimer co., it was extremely abundant at Gravesville, only 7 miles north. A little damage by this insect was reported from Tompkins county. This record is somewhat different from that of last year and decidedly so from the one for 1900.

Bud moth, *Tmetocera ocellana* Schiff. This little insect appears to be on the increase in Genesee county according to the statements of Mr J. F. Rose, of South Byron, who considers it one of the worst pests of the orchard in that section of the country. The most dangerous feature in connection with this insect is the occurrence of the hungry, voracious, partly grown larvae on trees when the young foliage is developing, and when a small amount of feeding will produce a relatively large amount of damage. It can be controlled, as has been repeatedly demonstrated, by thorough spraying with an arsenical poison just as the buds are unfolding.

Apple leaf *Bucculatrix*, *Bucculatrix pomifoliella* Clem. This is a well known enemy of the apple in the western part of the State at least and is occasionally exceedingly abundant. Mr L. L. Woodford, of Berwyn N. Y., has recently called our attention to 150 trees which were very badly infested with this insect. Examples of the twigs accompanying his communication were nearly covered in places with the characteristic white or yellowish cocoons. The general appearance of the insect is represented in the accompanying figure. It may be controlled by thorough spraying in early June with an arsenical poison.

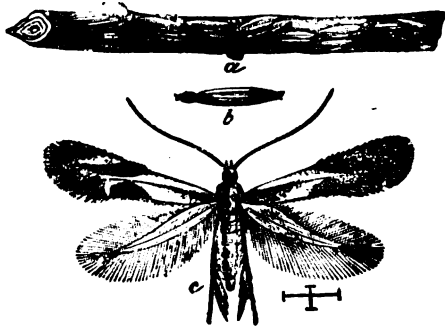


FIG. 2 Apple leaf *Bucculatrix*, *Bucculatrix pomifoliella*; a, piece of twig covered with cocoons; b, cocoon enlarged; c, the moth, enlarged

Small fruit insects

Raspberry cane maggot, *Phorbia rubivora* Coq. This species has been noticed from time to time on account of its

injuries to blackberry and to raspberry canes, and last May our attention was called to damage, probably the work of this insect, by Mr J. S. Kimberly, of Hamilton N. Y., who states that the maggots were quite destructive to blackberry and raspberry fields in that locality.

The parent insect is a small fly, and the most practical method of checking this species is by cutting the wilted tips well below the point of injury as soon as they appear and burning them.

The raspberry cane-girdler is a small beetle known as *Oberrea bimaculata* Oliv., and works in a similar manner. It may be distinguished from the preceding by the fact that it does not begin its burrows till in June, and that the wilting is caused by series of punctures forming two rings around the cane from $\frac{1}{2}$ to 1 inch apart, which the small beetle makes with its mandibles, and between which the egg is deposited. The latter insect may be controlled in the same manner as the preceding.

Grass and grain insects

Clover mite, *Bryobia pratensis* Garm. This little mite is a very common species and occasionally is present in immense numbers toward the end of the season, at which time it may cause serious injury by sucking the vital fluids from the leaves.

Mr L. L. Woodford, of Berwyn, has recently called our attention to what, for this State, is an abnormal abundance of the eggs. He states that one peachtree was so badly infested that many square inches of its surface presented a red color on account of the abundant eggs. In some places areas the size of a silver dollar appeared as if splashed with red paint. A twig, submitted with his communication, showed myriads of the characteristic eggs around every bud and at the base of each branch. They were so numerous as to give a distinct red coloring to an irregular area around each prominence. Dr C. L. Marlatt has recorded instances where the eggs were much more numerous on trees in the western states, but, so far as known to us, this species is not usually so abundant in the East. The eggs may be destroyed, as shown by experiments of Prof. C. P. Gillette, by spraying in winter with the standard kerosene emulsion diluted with but 5 parts of water. It is very probable that the 10% or 15% mechanical

crude petroleum emulsion would be just as effective and on some accounts preferable.

Corn worm or bollworm, *Heliothis armiger* Hübn. This southern species is well known on account of its serious depredations on cotton, and occasionally it is brought to notice in the northern states because of injuries to corn or tomatoes.

Dr M. W. Van Denburg, of Mount Vernon N. Y., reports this species as being unusually abundant in that section, where it occurred on sweet corn during the latter part of August. He states that the larvae eat the succulent husks, the kernels and also the juicy cob, leaving their burrows full of a brownish, moist excrement, in which they seem to be packed. He adds that the larvae occurred in about 10% of the ears.

Hessian fly, *Cecidomyia destructor* Say. The serious depredations of this grain pest were recorded in a preceding report; and the statement that practically no harm has been inflicted during the past season, not even in cases where white or no. 6 wheat was so seriously damaged the preceding year, is worthy of record.

Pea weevil, *Bruchus pisi* Linn. This little insect is a species which occurs somewhat commonly in peas, and its presence is too frequently overlooked or regarded as of comparatively little importance, and those planting a few peas or even growing them on a considerable scale, pay little or no attention to whether the seed is infested by this insect or not. As a matter of fact, this subject is one of considerable importance, particularly in Canada, where the species has caused enormous losses in recent years, and, unless repressive measures are adopted or enforced, it may cause much damage in the United States. Aside from direct injury, it is a well established fact that peas infested by this species have not the commercial value of clean seed, since, as determined by Dr Fletcher, only 17% to 20% of the infested ones will germinate. This means that where the weevil is at all abundant in the seed, one half to four fifths of it may be worthless; and purchasers will do well to bear this in mind. The sowing of this seed not only results in a less than normal number of plants, but also aids the propagation of the insect; and it is very probable that a great many of these pests are eaten in green peas—something which is not agreeable to contemplate.

The species can be easily controlled, since it is confined to one food plant, namely peas, and hibernates either within the seed or in sheltered places.

If the peas for seed purposes are harvested early, promptly threshed and treated with carbon bisulfid, none of the insects will be able to survive; and Dr Fletcher states that if the peas be tightly inclosed in a paper bag, the weevils will be unable to escape from their prison, and, if the seed be held over till the second year, which may be done without injuring its germinating powers, all of the weevils will die, and consequently there will be no danger of the species propagating. This simple method involves little or no additional expense; and, if the large growers of seed peas will in turn cooperate and fumigate all of their stock, there should be comparatively little or no trouble from the species in future years. It would undoubtedly be good business policy for growers of peas to print on each package a statement that the seed has been properly fumigated; and buyers are urged to insist on this treatment or to apply it to seed before it is planted.

Shade tree insects

Elm leaf beetle, *Galerucella luteola* Müll. This serious enemy of elms in the Hudson river valley has inflicted considerable injury during the past season, though it does not appear to have been quite so abundant in Albany and vicinity as in earlier years. It has also been reported as present in reduced numbers at Annandale, Dutchess co. It still ranks however as a pest of prime importance, and, where repressive measures, such as spraying with an arsenical poison, are not employed, many trees have sustained very serious injuries. The insect is gradually extending its range in the upper Hudson and lower Mohawk valleys, as is evidenced by its being widely distributed and quite injurious at Schenectady and also by its location recently in large numbers at Saratoga Springs. The latter outbreak is of considerable interest, because it is the most northern locality where very serious injuries have been caused by this species. It was hoped a few years ago that climatic conditions in this and similar localities would prevent serious depredations. This opinion has been refuted by its work in 1902; and it now remains to be seen whether the insect will prove to be seriously destructive for a

term of years. A recent note¹ by Prof. M. V. Slingerland states that this species occurs in small numbers at Ithaca N. Y.

White marked tussock moth, *Notolophus leucostigma* Abb. & Sm. This is one of the well known serious enemies of our shade trees in some of the larger cities of the State; and it is not unusual to see a number of horse-chestnut trees defoliated by the caterpillars. The cities of Albany and Troy have been comparatively free from this species in recent years, because in all probability, of the active measures employed for the control of the elm leaf beetle, which naturally resulted in other insects receiving the same treatment when their unusual abundance rendered it necessary. The work of this insect was exceedingly prevalent during the past season in the city of Buffalo, where it defoliated thousands of horse-chestnut trees over a considerable portion of the city. It was an exception to find one which had escaped injury, and the foliage of practically all of the trees was destroyed.

This species occasionally produces two generations a year in the vicinity of Albany, a fact which has not been previously recorded. The writer's attention was drawn to a number of the caterpillars of this insect on a small, soft mapletree in Albany in the early part of September. These were undoubtedly a second generation, and occasionally individuals of the same species have been met with here and there during the latter part of the summer. This is very interesting, since this species is known to produce two generations normally in Boston and New York, while at Albany and probably some distance south a single brood is the rule.

Fall webworm, *Hyphantria textor* Harris. This is one of the injurious general feeders, which is usually present each year in greater or less numbers in some section of the State. It was unusually abundant and destructive in the southern counties, particularly in Orange and Rockland, where its nests were very conspicuous in many trees. It was also reported as quite abundant and destructive in some of the western counties, specially in Genesee, where it was stated to be more numerous than Mr J. F. Rose had even seen before. This species is such a general

¹Entomological News, Jan. 1903, 14:30.

feeder that under ordinary conditions it does not inflict serious damages, and is usually fairly well controlled by natural enemies.

Black banded Lecanium, *Lecanium nigrofasciatum* Perg. This small insect has previously attracted comparatively little attention in this State. It was noticed briefly in our previous report and was brought to the attention of Dr Lintner in 1896, by examples sent from Poughkeepsie, where it had been exceedingly abundant on a hard maple. It has been observed in relatively small numbers on soft maples in Albany till the last few years, when it has become plenty on certain trees, and during 1902 it was found to be present in immense numbers on many soft maples. The insects were so abundant that a large amount of honeydew was excreted, and the growth of the trees seriously checked by its work.

Forest insects

Willow and poplar curculio, *Cryptorhynchus lapathi* Linn. This destructive weevil has been quite injurious to nursery stock in western New York during the past season. Its presence is usually indicated externally, in the case of willows, by a purplish discoloration of the bark on either side of the transverse burrow and by the drying and shrinking of the thin bark directly over the gallery.

The full grown larva or grub burrows in the center of small stems, frequently for a distance of 3 or 4 inches, and the pupal cell is found near the extremity of this burrow [pl. 6, fig. 1]. The galleries of the young grubs occur around buds and at the base of small limbs and frequently partly girdle the tree. Their presence is not so conspicuous as the work of older individuals and is usually indicated by a brownish discoloration with a few minute borings near the entrance.

Larvae, pupae and adults were found in infested stock submitted for examination July 18. A number of adults were bred in the course of a few weeks. The insect was so abundant in some nurseries as to cause serious loss and, on account of its working within the stems, is a difficult one to control. The destruction by fire of badly infested trees appears to be the most practical method of checking it, though something may possibly be accomplished by spraying the stems of young willows and pop-

lars with a repellent insecticide, such as whale oil soap or the carbolic soap wash. These applications should be made about the first of July and probably repeated toward the latter end of the month, the time for second treatment depending somewhat on the amount of rain.

Nun moth, *Psilura monacha* Linn. Our attention has recently been called to the reported presence of this European insect at Brooklyn N. Y. According to the published account,¹ Mr George Franck stated that, on looking over the small collection of a local collector during the summer of 1901, he found among other material five individuals of this species, which he identified by comparison with European specimens, of which he possessed a number. The collector in question had no communication with others than Mr Franck, from whom he obtained material in exchange, and, when he was questioned regarding this species and its occurrence, Mr Franck was assured that the specimens had been captured at light in Brooklyn. No other person who had been consulted in regard to this species knew anything of its occurrence in that vicinity, and it was put down as an accidental importation, which is possibly true. The person who made the capture resides in a district where there are numerous lumber yards, and shipping is quite extensive. The location is described as being around North 2d street and Metropolitan avenue, near a creek which adjoins that portion of the bay running through the eastern part of Brooklyn. Since only five of the insects were taken, it may not be that the species has been introduced; but, as pointed out by Dr Howard, we may have here a parallel case to that of the gipsy moth, *Porthetria dispar* Linn., which was known to be actually introduced into this country 25 years before it attracted the attention of economic entomologists. The two species are related and have similar habits; and there is reason to believe that, if this species does become permanently established in the vicinity of New York, it will prove a serious enemy and perhaps be even more troublesome than the gipsy moth. The latter was established inland, while the nun moth, if it has obtained a foothold, will probably spread to the immediate vicinity of water ways on either side. This feature

¹Howard, L. O. U. S. Dep't Agric. div. ent. Bul. 88. n. s. 1902. p.90-91.

alone makes the matter of much greater importance, since vessels would afford the insect excellent opportunities to extend its range in this country, and there would be much greater difficulty, if it should become at all abundant, in limiting the spread of the species than was the case with the gipsy moth.

The parent insects are said to fly during July and August. The moths are a grayish or yellowish white, irregularly marked on the fore wings with dark brown or black, as shown on plate 6, figure 2. The hind wings are a pearly gray and margined with grayish brown spots. The abdomen is transversely marked with more or less distinct black bands interspersed with a reddish or rosy hue. The female has a wing spread of nearly 2 inches and the male about an inch and a half. The latter may be recognized by its smaller size and the pectinate antennae.

The larva has been described by Furneaux as follows: "The caterpillar is hairy, and of a grayish white color. A brown stripe runs down the back. On the top of the second segment are two blue tubercles; and there is also a tubercle, of a reddish color, on each of the ninth, 10th and 11th segments."

The larva has been recorded as feeding on a number of trees, notably oak, birch, fir, pine and apple, becomes full grown in June or July, and is specially injurious to spruce forests.

This species, as recorded by Myrick, is sometimes exceedingly destructive to fir forests on the continent, stripping the trees so completely as to kill them. A more detailed account of what this insect will do is given by Professor Fernow, now director of the New York State College of Forestry. He states¹ that the ravages of this insect in Europe from 1853 to 1867 involved an area of over 100,000 square miles and destroyed 55,000,000 cords of wood, necessitating the premature cutting of 7,000,000 cords to save it from subsequent attack by bark beetles. The attack in 1891 at first involved some 20,000 acres of spruce in upper Bavaria, but soon reports were received from all parts of Germany, Austria, Bohemia, etc., indicating an unusual abundance of the insect, so that many thousand square miles of forest were involved. Over \$8000 were spent in the first named district in checking the ravages of the insect, and a special committee was

appointed by the Bavarian government to discuss and advise measures to prevent the further spread of this species. The situation was so grave that the German government in 1891 appropriated \$350,000 to fight this pest, most of which was expended on banding with an insect lime.

Walnut worm, *Datana integerrima* Gr. & Rob. This is our most common species belonging to the genus and one which is annually present in greater or less numbers in the western part of the State. It defoliated many butternut and walnut trees in Genesee county during last summer, as reported by Mr J. F. Rose, of South Byron; and our observations showed that it was also extremely abundant in Chautauqua county, where a considerable number of trees suffered severely from its ravages. Some of the smaller and worse infested trees lost most of their foliage, while the larger ones suffered to a less extent.

Birch leaf *Bucculatrix*, *Bucculatrix canadensisella* Chamb. The extensive depredations of this insect [pl. 6, fig. 3] in 1901 were noticed in a previous report. The species has not been quite so abundant during the past season, though in the vicinity of Karner a large proportion of the birches were practically skeletonized. State botanist Peck has also informed the writer that it was exceedingly injurious in the vicinity of Lake Placid. The work of the pest was so general in that section that clumps of birches could be recognized at a distance by their uniform brown color.

17 year cicada, *Cicada septendecim* Linn. The brood of this insect, due to appear in New York State the present year, was a very limited one; and the following localities, kindly communicated to me by Mr Chester Young, of Ellenville, are placed on record. The insects were observed by him at Wantagh, Nassau co.; also between Massapequa and Amityville, between Sayville and Oakdale, east of Patchogue to Brookhaven, and also to the north of Medford and Holtsville, and a small brood northeast of Riverhead, all in Suffolk county.

The writer has been unable to verify the occurrence of the insect in either Monroe or Niagara counties, where it had been reported in earlier years.

Household insects

Webbing or southern clothes moth, *Tineola biselliella* Hummel. This species is a southern form, which is stated by

Messrs Howard and Marlatt to be the more common one in the latitude of Washington. It also occurs farther north; and the breeding of it in considerable numbers from insects which had been in our collection for some years is worthy of record, though it is not a new habit, since the larva is known to feed on a variety of animal substances and has been previously recorded as occurring in collections. It was abundant enough in our own, so that one large moth was nearly destroyed, and a number of others injured, and it is apparently a form which would cause considerable damage if allowed to breed undisturbed.

Beneficial insects

Twice-stabbed Chinese ladybug, *Chilocorus similis* Rossi. The establishment of *Aspidiotus perniciosus* Comst. at San José Cal., and its subsequent spread to and injuries in many of the eastern states have led to active seeking for means of controlling this pest. Countless experiments with various insecticides have been carried out, and considerable attention has been given to ascertaining the original home of this species, in hopes that some natural enemy might be found there which would prove of great service in checking it. The personal investigations of Dr C. L. Marlatt in Japan and China in 1901 led this gentleman to conclude that the original home of this species was in northern China, and its most effective natural enemy in that section was the above named ladybug, and he shipped living examples of this species to Washington D. C., where they were carefully reared for the purpose of ascertaining their value. We were fortunate enough to obtain 50 adult beetles last August, and have since kept them on a badly infested tree inclosed in a tight, wire-covered breeding cage. The insects were placed on the tree Aug. 13, and a number of them were observed investigating young scales very shortly after being liberated. Examination Aug. 22 showed that the beetles were apparently healthy, though there were no signs of eggs or grubs, and some of the scale insects appeared to have been eaten. Early the next month one beetle was found, but no evidence of breeding was observed. Sep. 23 an examination by Mr Young resulted in finding about 150 larvae or grubs, which were working almost entirely on the southern side of the tree. There were more of the insects on twigs than on

leaves, and fewer scales were observed on the portion of the tree where the predaceous larvae were most abundant, since the scale insects were not clustered along the midribs of the leaves where the grubs occurred, as was the case in portions which appeared to be free from them. Oct. 17 the cage was again visited, and a few living larvae or grubs, together with two or three living beetles and a considerable number of pupae, were found. Five or six pupae were observed on the wire side of the cage, and there was considerable evidence of the larvae having eaten large numbers of the scale insects.

This species resembles our native twice-stabbed ladybug, *Chilocorus bivulnerus* Muls., so closely that only a specialist can separate the adults. There is more difference between the larvae of the two species, the skin of the imported form being reddish or a flesh tint, while that of our native species is dull gray. The larval spines of the introduced species are less prominent and differ structurally from those of our native ladybug. There appears to be no reason why our native species should not be equally valuable in checking this scale insect, but at present at least this introduced form seems to be much more effective, and it may prove to be an exceedingly valuable ally in combating this most pernicious scale insect.

Praying mantis, *Mantis religiosa* Linn. The distribution of the eggs of this beneficial species in a number of localities in the Hudson and Mohawk river valleys was recorded in our preceding report, and the statements of some of the recipients that eggs hatched and individuals developed were also published. It is worthy of record that the eggs of this species were reported by George S. Graves, Newport, as hatching June 22 of the present year, and Mr W. C. Hitchcock, Pittstown, states that a nearly full grown individual was taken by him Sep. 8, and that several others were observed by neighbors. There is a bare possibility of a mistake in some of the above records; and yet the appearance of this insect is characteristic, and, as each of these gentlemen were supplied with figures of the insect, it hardly seems as if there could be any doubt of the insect having become established in these two localities.

Chinese praying mantis, *Tenodera sinensis* Saussure. It is interesting in connection with the above to note that this large species has already become established in New York city and its vicinity, as stated by Mr L. H. Joutel.

This insect was first brought prominently to the attention of American entomologists in 1898 by Philip Laurent publishing a brief notice of its occurrence in the vicinity of Philadelphia in the issue of the *Entomological News* for June. In a later issue Mr Laurent states that he received the first specimen from Mr Mehan of the firm of Thomas Mehan & Sons in 1896. Later reports state that the insect has become well established in Philadelphia and apparently is able to hold its own in that climate. It appears to be thriving in the vicinity of New York city and may prove to be a valuable addition to our fauna, since it preys on other insects, and can hardly be otherwise than beneficial.

IMPORTANCE OF INJURIOUS INSECTS INTRODUCED FROM ABROAD¹

One can not help being interested in the sources of our troubles; and the writer recently had occasion to look up some of the facts concerning introduced species, which, though they are well known, are worthy of further emphasis. It is generally conceded that some of our most troublesome insect pests are those which have made their way to us from abroad, and, while this is accepted as an authentic statement, its importance is not fully realized. The depredations of these introduced species are becoming more and more apparent, and the present indications are that in the future even more strenuous efforts must be made to subdue some of these insects. Let us glance briefly at the conditions in several portions of our country.

The commonwealth of Massachusetts now has within its borders two exceedingly injurious insects, which are bound sooner or later to make their way over a considerable portion of the United States. That commonwealth made a determined effort to exterminate the gipsy moth, *Porthetria dispar* Linn., and after the expenditure of over one million dollars abandoned the

¹ Read before the Society for the Promotion of Agricultural Science at its meeting held in Washington D. C. Dec. 22, 1902.

task. The insect is now becoming more and more abundant, has established itself in Rhode Island and is gradually extending its range. The brown tail moth, *Euproctis chrysorrhoea* Linn., has also become established in that state, is known to occur in New Hampshire and Maine and is rapidly extending its range. The elms of that commonwealth are seriously injured by the imported elm leaf beetle, *Galerucella luteola* Müll., which has made its way over a considerable proportion of the state and is being assisted in its destructive work by the imported elm bark louse, *Gossyparia ulmi* Geoff. It would seem as if this might be sufficient, but apparently not, since the dreaded San José scale, *Aspidiotus perniciosus* Comst., is also established in a number of localities in that state and is proving true to its reputation in other places.

The condition of New York State is not much happier than that of its sister commonwealth, though as yet it is free from the gipsy and brown tail moths. Our elms, however, are badly injured from year to year by both the elm leaf beetle and the elm bark louse, and the shade trees in the vicinity of New York city are seriously ravaged by another imported insect, the leopard moth, *Zeuzera pyrina* Linn., a species which thrives in a large number of trees and when not checked inflicts extensive injuries. Our fruit trees are suffering here and there from excessive infestation by San José scale. The pear psylla, *Psylla pyricola* Forst., occasionally inflicts great injury on this fruit tree in various portions of the State.

In the South, we find the cotton boll weevil, *Anthonomus grandis* Boh., threatening the cotton crop of Texas, while the harlequin cabbage bug, *Murgantia histrionica* Hahn., has established itself in numbers in most of the southern states and is proving an exceedingly serious enemy of cruciferous crops. The imported peach scale, *Diaspis pentagona* Targ., is another recent introduction which has become established in several localities in the southern states and bids fair to rival in destructiveness the San José scale. It is also established in one or two localities in the north.

These are all insects which have been introduced into this country within comparatively recent years and which are proving pests of first importance. It is interesting in this connection to

observe where these and other introduced species first became established in the country. The gipsy and brown tail moths, *Porthetria dispar* Linn. and *Euproctis chrysorrhoea* Linn., were first detected in Massachusetts, while the elm bark louse, *Gossyparia ulmi* Geoff., the Hessian fly, *Cecidomyia destructor* Say, the common asparagus beetle, *Crioceris asparagi* Linn., the leopard moth, *Zeuzera pyrina* Linn., the Buffalo and black carpet beetles, *Anthrenus scrophulariae* Linn. and *Attagenus piceus* Oliv., and the European fruit tree scale insect, *Aspidiotus ostreaeformis* Curt., were first detected in New York State or its immediate vicinity, in the case of the leopard moth; and, according to recent reports, we may find that the nun moth, *Psilura monacha* Linn., has become established in the vicinity of New York city. Another imported insect, *Coleophora limosipennella* Dup., which may prove very destructive to elms, was recently brought to our attention on account of its occurrence in large numbers on Scotch elms in Brooklyn. The 12 spotted asparagus beetle, *Crioceris 12-punctata* Linn., was first detected in the vicinity of Baltimore, as is also true of the elm leaf beetle, *Galerucella luteola* Müll.

The few records given above indicate that a considerable number of the imported insects make their way to this country through the port of New York and naturally become established in the immediate vicinity of New York city or else at one of the great centers of the nursery trade in the western part of the State. Considerably fewer species come into the country through the port of Boston or through others south of New York. It may never be possible or practicable to attempt the establishment of a quarantine on our eastern coast, but it is certainly advisable for us to maintain a close watch (as is now done in New York by agents of the State Department of Agriculture) at these points of danger, in order that we may detect the advent of other injurious species and see that they are adequately controlled.

The injuries inflicted by the various imported insects are simply enormous and in most cases entirely beyond calculation. The

wheat midge, *Diplosis tritici* Fitch, inflicted in 1854, according to the estimates of Dr Fitch, a loss of \$15,000,000 in New York State, or reduced the crop by about 7,000,000 bushels. A conservative estimate of the damage during the same year, by J. H. Klippart, secretary of the Ohio State Board of Agriculture, places the loss in that state at from 5,000,000 to 7,000,000 bushels. Two years later Dr Fitch estimated that from one half to two thirds of the wheat crop on the uplands of Livingston and Monroe counties was destroyed, and that nearly all of that on the flats, the latter comprising at least 2000 acres, was not harvested. Dr Fitch further states that the loss in 1857 probably exceeded that of 1854, and that one third of the entire crop, or about 8,000,000 bushels, was destroyed in Canada. The periodical injuries by the Hessian fly, *Cecidomyia destructor* Say, are well known, and it is not necessary to refer to them more than to mention that in 1846 it was estimated that in the western section of New York State there was a loss of not less than 500,000 bushels, and in our recent outbreak in 1901, the damage in New York State was placed at \$3,000,000. Dr Marlatt has estimated that the loss in the Ohio valley on the crop of 1899-1900 amounted to from \$35,000,000 to \$40,000,000, and he places the minimum annual loss in the chief wheat growing sections of the country at 40,000,000 bushels and over. The exceedingly common codling moth, *Carpocapsa pomonella* Linn., is well known as a destructive insect; and it may be interesting to record Dr Forbes's estimate of \$2,375,000 as the annual loss caused by it in the State of Illinois, while Professor Slingerland has placed the average damage in New York State at \$3,000,000. In the southern states, enormous injuries by the cotton worm, *Aletia argillacea* Hübn., are well known. The average loss in the cotton states for the 14 years following the Civil War was estimated by Dr Packard at \$15,000,000, and that for 1873 was placed by the same author at \$25,000,000. Later, in 1877, he estimates the annual loss as ranging from \$25,000,000 to \$50,000,000. These are a few examples of what some of our introduced insect pests have done, and represent only a very small fraction of the entire loss, which in many cases can not be estimated with any approach to accuracy. It should perhaps be

added that the imported fluted scale, *Icerya purchasi* Mask., threatened the entire citrus fruit industries of California in the 80's and was effectually subdued only by the importation of natural enemies.

We have made an attempt to classify these imported insects according to their destructiveness or prospective importance; and the following annotated lists give our judgment regarding some of these forms.

INTRODUCED SPECIES OF PRIMARY ECONOMIC IMPORTANCE

Affecting fruit trees

San José scale, *Aspidiotus perniciosus* Comst. This species, though recently introduced, is already widely distributed over the United States and easily ranks as one of the most injurious scale insects in the country and is probably as destructive as any other imported form.

The black scale, *Lecanium oleae* Bern., is very injurious, particularly to oranges and lemons in southern California.

The codling moth, *Carpocapsa pomonella* Linn., is one of our older pests and yearly causes great losses, as mentioned in a preceding paragraph.

The brown tail moth, *Euproctis chrysorrhoea* Linn., is one of our most recently introduced species, which promises to be not only quite injurious to peartrees, but also very annoying to man, since the irritating hairs of its caterpillar have caused very serious inflammations, in neighborhoods where the insect was numerous.

The gipsy moth, *Porthetria dispar* Linn., though of comparatively recent introduction and still confined to a somewhat limited territory, is a species of prime economic importance and may eventually become one of the most destructive in the country. It fortunately spreads slowly and may be controlled locally.

The pear psylla, *Psylla pyricola* Forst., though first detected in Connecticut, probably entered the country through the port of New York and is exceedingly destructive to peartrees in some years. It has obtained a wide distribution in New York State and is known to occur as far west as Illinois.

Affecting shade trees

The elm leaf beetle, *Galerucella luteola* Müll., is a species which is at present confined largely to the Atlantic coast and during the last four or five years has been extending its range northward, particularly in New York and Massachusetts, where it has been exceedingly destructive, and easily ranks as one of the most serious enemies of elms.

The leopard moth, *Zeuzera pyrina* Linn., is limited largely to the vicinity of New York city, where it has proved very injurious to soft maples in particular, though it has been recorded as depredating on a great many other trees.

Affecting grains

The Hessian fly, *Cecidomyia destructor* Say, is a well known destructive species, which occasionally causes exceedingly severe losses and is more or less injurious every year in some section of the country.

The grain aphid, *Nectarophora granaria* Kirby, is exceedingly destructive in some years to grains in certain sections, and there is no practical method of controlling it.

A grain louse, *Toxoptera graminum* Rond., is a recent introduction and has proved very injurious to wheat in Texas.

Affecting cotton and other crops

The cotton worm, *Aletia argillacea* Hübn., is a well known and exceedingly injurious insect in the South.

Its associate, the boll worm or corn worm, *Heliothis armiger* Hübn., is exceedingly injurious and may have had a foreign origin.

The cotton boll weevil, *Anthonomus grandis* Boh., is a species which has recently become established in Texas, where it has already inflicted enormous damages and is proving exceedingly difficult to control.

The hop plant louse, *Phorodon humuli* Schrank, is a serious enemy of this crop, which occasionally causes very great losses and is more or less destructive each year.

The cabbage maggot, *Phorbia brassicae* Bouché, is very destructive to cabbages in various sections of the United States and has led to the abandonment by many growers of early cab-

bage, cauliflowers and radishes about New York city, according to Peter Henderson, who records the destruction of tens of thousands of acres in 1887.

The destructive pea aphid, *Nectarophora pisi* Kalt, is a species which has caused widespread loss to extensive pea-growers in the Atlantic states and has led many to abandon the late varieties in order to escape its ravages.

RECENTLY INTRODUCED SPECIES WHICH MAY BECOME VERY
DESTRUCTIVE

The sinuate pear borer, *Agilus sinuatus* Oliv., is established in the vicinity of New Brunswick N. J.

The recently imported West Indian peach scale, *Diaspidiotus pentagona* Targ., is very injurious where established in the southern states and is known in a few localities in Massachusetts.

The European fruit tree scale insect, *Aspidiotus ostryaeformis* Curt., is established in New York State and in a number of other localities in this country, but as yet has not proved markedly injurious.

The wheat sawfly, *Cephus pygmaeus* Linn., has become established in several localities in this country, but has not proved very injurious, though it is a well known enemy of wheat in Europe.

An interesting case-bearer, *Coleophora limosipennella* Dup., was brought to the speaker's notice last year, when it was inflicting considerable injury on Scotch elms at Brooklyn. It is apparently a recently introduced species.

The willow and poplar curculio, *Cryptorhynchus lapathi* Linn., has become established in a number of widely separated localities and has proved quite injurious to nursery and other young trees in particular.

OTHER INTRODUCED SPECIES

Most of the forms included in this list are quite destructive at times, though not as a rule so injurious, or likely to become so, as those in the preceding lists. Most of them are so familiar that comment is unnecessary.

Species affecting fruit trees

Pear midge, *Diplosis pyrivora* Riley

Bud moth, *Tmetocera ocellana* Schiff.

Cherry and pear slug, *Eriocampoides limacina* Retz.

Apple aphid, *Aphis mali* Fabr.

Cherry aphid, *Myzus cerasi* Fabr.

Pear blight beetle, *Xyleborus dispar* Fabr.

Fruit tree bark beetle, *Scolytus rugulosus* Ratz.

Appletree bark louse, *Mytilaspis pomorum* Bouché.

Orange bark louse *Mytilaspis citricola* Pack.

Greedy scale insect, *Aspidiotus camelliae* Sig.

Fluted scale, *Icerya purchasi* Mask.

Species affecting small fruits

Currant sawfly, *Pteronus ribesii* Scop.

Currant stem borer, *Sesia tipuliformis* Linn.

Rose scale, *Aulacaspis rosae* Sandb.

Species affecting miscellaneous crops

Larger cornstalk borer or sugar cane borer, *Diatraea saccharalis* Fabr.

Common asparagus beetle, *Crioceris asparagi* Linn.

12 spotted asparagus beetle, *Crioceris 12-punctata* Linn.

Cabbage aphid, *Aphis brassicae* Linn.

Harlequin cabbage bug, *Murgantia histrionica* Hahn.

Onion maggot, *Phorbia ceparum* Meig.

Seed corn maggot or locust egg anthomyian, *Phorbia fusiceps* Zett.

Variegated cutworm, *Peridroma saucia* Hübn.

Xylophasia arctica Bdv.

Cabbage butterfly, *Pieris rapae* Linn.

Cabbage worm, *Plutella cruciferarum* Zell.

Imported cabbage webworm, *Hellula undalis* Fabr.

Carrot rust fly, *Psila rosae* Fabr., has been known in Canada for some years and was first detected in New York State in 1901.

Clover leaf weevil, *Phytonomus punctatus* Fabr.

Mamestra trifolii Rott.

Clover root borer, *Hylastes trifolii* Müll.

Clover hay worm, *Pyralis costalis* Fabr.

Prolific Chlorops, *Chlorops variceps* Loew.

Affecting forest trees

Larch sawfly, *Lygaeonematus erichsonii* Hart.

Woolly larch aphid, *Chermes strobilobius* Kalt.

Birch seed midge, *Cecidomyia betulae* Winnertz

The European willow gall midge, *Rhabdophaga salicis* Schrank, was recently detected by us in central New York, where it has caused considerable injury by infesting willows grown for binding nursery stock.

Golden oak scale insect, *Asterolecanium variolosum* Ratz.

Elm bark louse, *Gossyparia ulmi* Geoff.

Affecting domestic animals

Horn fly, *Haematobia serrata* Rob.-Desv.

Screw worm, *Lucilia macellaria* Fabr.

Enemies to stored food products

This list comprises a number of widely distributed species, a few of which are exceedingly destructive.

Mediterranean flour moth *Ephestia kuehniella* Zell. This species is the most destructive mill pest known in the country, and when abundant may necessitate the cessation of operations and thorough cleansing before grinding can be resumed.

Indian meal worm, *Plodia interpunctella* Hübn.

The rice weevils, *Calandra granaria* Linn. and *C. oryzae* Linn.

The bean weevil, *Bruchus obtectus* Say.

The pea weevil, *Bruchus pisi* Linn.

Insects annoying or injurious in houses

This group comprises practically all of our species, as may be seen from the following list.

Case-making clothes moth, *Tinea pellionella* Linn.

Southern clothes moth, *Tineola biselliella* Hum.

Tapestry moth, *Trichophaga tapetzella* Linn.

Buffalo carpet beetle, *Anthrenus scrophulariae* Linn.

Black carpet beetle, *Attagenus piceus* Oliv.

Larder beetle, *Dermestes lardarius* Linn.

Little red ant, *Monomorium pharaonis* Linn.

House fly, *Musca domestica* Linn.

The bed bug, *Acanthia lectularius* Linn.

The cockroach, *Periplaneta orientalis* Linn.

The American cockroach, *Periplaneta americana* Linn.

The croton bug, *Phyllodromia germanica* Fabr.

Beneficial species

The general record concerning introduced species is not pleasant reading, but that of the forms which aid in subduing insect pests is one of the brightest pages of American economic entomology. The first prominent success met with in introducing predaceous enemies was the importation of the Australian ladybug, *Novius cardinalis* Mul., which was introduced in 1889 in hopes that it would check the destructive fluted scale, *Icerya purchasi* Mask., which then threatened the entire citrus industry of California. These hopes were realized in a most gratifying manner, and the ravages of that scale are now a matter of history.

Another valuable importation is that of the fig insect, *Blastophaga grossorum* Grov., a species which is absolutely essential for the production of the best quality of figs, and its presence has made possible the growing of the celebrated Smyrna figs in California. This was accomplished largely through the division of entomology of the United States Department of Agriculture and is another of the signal triumphs of applied or practical entomology. Another very recent importation, which may possibly prove of greatest practical benefit to American horticulture, is that of the Chinese ladybug, *Chilocorus similis* Rossi, a species which feeds readily on the San José scale and may eventually prove a very efficient factor in controlling it.

A list of the more important beneficial insects which have become established in this country is as follows:

A parasite of the fluted scale, *Lestophonus iceryae* Will.

The fig insect, *Blastophaga grossorum* Grov.

Hessian fly parasite, *Entedon epigonus* Walk.

Scutellista cyanea Motsch., a parasite of the black scale insect.

Cardinal ladybug, *Novius cardinalis* Muls.

Australian ladybugs, *Novius koebelei* Olliff and *N. bellus* Blackburn.

Chinese ladybug, *Chilocorus similis* Rossi.

Black ladybug, *Rhizobius ventralis* Erich.

A predaceous enemy of bark borers, *Clerus formicarius* Linn., introduced from Europe in 1892 by Dr A. D. Hopkins as a valuable predaceous enemy of certain very injurious bark borers.

European praying mantis, *Mantis religiosa* Linn.

Chinese praying mantis, *Tenodera sinensis* Sauss.

The two latter were accidentally brought into the country; and, while we expect that in the main they will be beneficial, apprehension is felt by some, and their introduction may not prove to be an unqualified benefit.

EXPERIMENTAL WORK AGAINST SAN JOSÉ SCALE INSECT

The experimental work against this insect begun in 1900 and continued in 1901 was further prosecuted during the past season, and the results of earlier years were largely confirmed.

The lime, salt and sulfur mixture, about which considerable has been written in the past 12 months, was also tested, and some valuable data obtained under various conditions. The results in earlier years from spring applications of whale oil soap in combination with crude petroleum and kerosene or its emulsions were such that it was not deemed advisable to continue further work with these substances. The combination of the soap with petroleum reduced the insecticidal value of the latter and made a somewhat safer combination, but increased the cost of the emulsion, so that its use can be advised only when no mechanical emulsion apparatus is at hand. The kerosene and its emulsions proved so unsatisfactory in early spring applications that no further work was attempted with it.

Fall applications

All our previous work had been done in early spring just before the buds began to open or just as they were unfolding, and though the results were exceedingly satisfactory some tests with fall applications were planned. These were all made Dec.

11, 1901. The day was an ideal one, there being very little or no wind most of the time and the temperature ranging from about 30° in the shade to 68° in the sun. The trees were dry, and, despite the fact that there had been considerable cold weather and much snow the previous week, the trunks of the trees, even to the very base, were well exposed; consequently the insecticide could be applied to the greatest advantage. Most of this experimental work was limited to an exceedingly badly infested orchard of young appletrees near Albany. A number of these were dying and a considerable proportion of them were in extremely bad condition, owing to the work of this scale insect.

20% mechanical crude petroleum emulsion. This mixture was applied to 23 appletrees in the above mentioned orchard. The oil was obtained of the Derrick Oil Co. of Titusville Pa., and, after being drawn from the barrel, tested 41.1° on the Beaumé oil scale. The spraying was carefully done, and, under the exceptional weather conditions noted above, practically every portion of each tree was covered with the mixture. The sprayed trees were numbered 344-66, and their condition at the time of spraying was as follows: nos. 344-347, 349, 350, 353, 355, 355a, 357, 361-363 were all very, very badly infested with the scale, a large proportion of the bark being literally covered by the pest. Trees 348, 352 and 359 were dead. Tree 351 was very badly infested, and trees 354, 358 and 364 were rather badly infested. A few scales were to be seen on tree 360, 365 was badly infested, and only a stump remained of tree 356.

In addition to the appletrees named above a number of other kinds of fruit trees on adjoining premises were sprayed with the crude petroleum. Most of these trees were in a fairly vigorous condition, though a few were somewhat badly infested by the scale.

An examination of the appletrees in midwinter raised considerable apprehension and it was feared that the insecticide had caused serious injury, but investigation Mar. 10 showed that the crude petroleum had not damaged the trees so much as was feared. The tips of some branches were dead, and a number of trees had died during the winter; but, as most of them were in very bad condition on account of scale infestation, it is hardly fair to attribute all the damage to the insecticide applied. In

most instances the living bark of the trees ranged from slightly green to a perfectly healthy green, and it was then expected that a goodly proportion would develop a fair amount of foliage. All the scale insects appeared to be killed. One peachtree in an adjoining orchard, which had been sprayed at the same time and under similar conditions with the 20% mechanical emulsion, was examined in March, and it was found that the fruit buds had apparently escaped all injury.

An inspection of the same trees May 6 showed that a number had died, though this is not surprising after allowing for the injuries by the scale insects and also for the damage done by the round-headed borer, which was exceedingly abundant in the orchard. The trees sprayed with the crude petroleum emulsion showed little or no more injury than those beside them treated with whale oil soap, and we are therefore inclined to believe that the petroleum inflicted relatively little injury.

This mechanical emulsion, as previously stated, was applied under the same conditions to other trees, and the observations made on them are of considerable interest. May 6 these other sprayed trees were examined with the following results. A Dutchess pear showed a few dead limbs, was not badly infested and bade fair to produce some blossoms. Another of the same kind was leafing out nicely and gave evidence of producing a number of blossoms. A Globe peachtree presented a very fair bloom, though some limbs were dead at the tips. The latter we are inclined to believe was due to the weather of last winter, because similar injury was observed on a number of untreated trees. Meeches prolific quinces, of which several bushes were treated, were in excellent condition and had an abundance of flowers. Several Bartlett peartrees possessed a very good foliage and an excellent bloom.

These and some other trees treated with crude petroleum emulsion the preceding December were also observed June 12 with the following results. A Lombard plumbtree was found to be nearly uninjured by the oil, while several Clapp's favorite peartrees were hurt to some extent, the bark cracking in places in the case of one tree and none bearing any fruit. Some injury and no fruit was true of a Bartlett peartree, while another bore considerable fruit and two others some. A Botan plumbtree had

several limbs killed by the oil, but the others were apparently all right. A Kieffer peartree was in excellent condition and had a little fruit. One Dutchess pear was apparently uninjured and bore no fruit, while another would produce some. Practically the same results were obtained on Beurre d'Anjou and Vermont Beauty peartrees. The Meeches prolific quince-trees bore out the promise of an earlier date and gave no evidence of having suffered in the slightest from the application. A yellow Gage plum was in excellent condition but bore no fruit, and the same was true of a natural cherry, except that it had a little fruit. A Magnum Bonum plum was in excellent condition and bore considerable fruit.

An examination of the apple orchard June 12 failed to reveal a single living scale insect; and, though some of the trees had developed adventitious shoots, their occurrence could hardly be attributed to the use of the oil, since they were almost equally common on the trees sprayed with whale oil soap. The plum-trees sprayed with the crude petroleum also developed a considerable number of adventitious shoots, and it is possible that they were injured by the oil, though such is not necessarily the case.

An examination of these trees Nov. 11 by my assistant, Mr Walker, showed that a few were very badly infested by the scale, that some were badly infested and that several were dead. The owner, since the treatment of the previous fall, had set a number of new trees in vacant places. Most of these and some of the others were in good condition.

In passing judgment on this experiment, it should be remembered that no treatment whatsoever was given after the spraying in December, and that, before the end of the season, the few scale insects which presumably escaped destruction had an excellent opportunity to multiply. Up to the middle of the summer at least there were very few living scale insects to be seen on these trees; and we can not help feeling that, while the insects are now abundant on a number of the trees, the application proved very efficient and was perhaps as effective, though somewhat injurious, as any spray which could be applied.

Good's caustic potash whale oil soap no. 3. This insecticide was applied at the rate of 2 pounds to the gallon to 315-28 and

331-43 in the above named young apple orchard and under conditions previously described. The condition of these trees so far as noted at the time of treatment, Dec. 11, 1901, was as follows. Trees 317, 320, 321, 322, 323, 324, 325, 326, 327, 333, 334, 335, 336, 338, 340, 341 and 342 were extremely badly infested with the scale; trees 319, 330, 332 and 343 were very badly infested, and trees 316 and 331 were rather badly infested; there were only a few on tree 339 while trees 315, 318, 328 and 337 were dead. 34 other fruit trees on an adjoining place were also sprayed with this solution, except that a little of Good's tobacco whale oil soap no. 6, 2 pounds to the gallon, remained in the barrel when the solution of no. 3 was added. There was however very little of the tobacco whale oil soap solution, and the effect would hardly be modified.

The examination of the above mentioned trees Mar. 10, 1902, showed that apparently all of the scale insects had been killed by the treatment, and so far as noted no injury to the trees occurred. The same was true of a later examination made May 6, and there was no material change in conditions so far as noted June 12. An examination of the appletrees Nov. 11, 1902, by my assistant, Mr Walker, showed that a few of the trees were very badly infested, some badly infested and others in good condition. The application appears to have checked the pest very thoroughly till toward the latter end of the season, when the few which survived the treatment were able to multiply and reinfest the trees to a considerable extent.

Good's tobacco whale oil soap no. 6. This compound was used in a solution of 2 pounds to the gallon and was applied to 11 small appletrees in the above described orchard and to nearly 20 greengage plumbtrees on the northern boundary of the same. The condition of the appletrees at the time of spraying was as follows. Trees numbered 303, 307, 308 and 313 were very very badly infested. Trees 305, 310 and 314 were dead except in the case of 310, which had developed a few suckers; 311 was nearly dead. There were a few scales to be seen on trees 304, 306 and 312, and 309 and 311 were very badly infested.

An examination of these trees Mar. 10 showed that apparently every scale insect had been destroyed by the application, and the same was true of a later examination May 6. This condi-

tion was not materially changed June 12, and an examination Nov. 11 by my assistant, Mr Walker, showed that two were very badly infested, some others badly infested and a few in a good condition. This row of trees was in such bad condition at the outset, and so many of them were nearly dead or had died during the winter, that the actual record does not do justice to the insecticide. Comparative observations led us to believe that this tobacco whale oil soap solution was possibly a little more effective in destroying scale insects than the more commonly employed caustic potash whale oil soap no. 3.

Linseed oil. Several trees were carefully painted with this substance Dec. 11, 1901, by my assistant, Mr C. M. Walker. The treated trees were as follows: tree 226, a small apple, and 227, a small peach, and 330, a very badly infested appletree, were painted with the boiled linseed oil. The raw linseed oil was similarly applied to an exceedingly badly infested appletree, no. 329. It was found that a small tree required about $\frac{1}{2}$ pint of the oil, and nearly two hours were occupied in applying the substance.

Mar. 10 the linseed oil could be easily seen on treated trees, and on May 6 it was seen that two appletrees, 329 and 330, were in a very serious condition and likely to die. June 12 it was found that 330, which was painted with the boiled linseed oil, was killed back to the stump and was then developing a very few shoots, while tree 329, which received the raw oil, was dead. This substance undoubtedly killed the scales and was apparently almost equally destructive to the trees. Its use in the fall certainly can not be advised.

Spring applications

The tests with various sprays in early spring were continued last spring, and the results of earlier years have been largely confirmed.

20% mechanical crude petroleum emulsion. This mixture was applied Ap. 7 to about 70 trees, representing a number of the more common varieties. The day was cloudy, and the trees were damp at 11 a. m., so that no spraying was undertaken till 1 p. m., at which time the trees were dry, though it was not what would be characterized as a drying day. The buds of some varieties of

pears had begun to open. This insecticide was applied to the following trees: 15-28, 34-47, 60-74, 79-91, and 101-14, or in other words, to the western end of our experimental orchard, a map of which was published in our report for 1900. The general character of the trees and their varieties have been previously published and can be ascertained by referring to the above report. Tests of the mechanical dilution were made while the work was in progress with the following results. At tree 19, 5% oil was delivered; at tree 87, a little over 12.3%; at tree 108, 14%; at tree 104, 12.5%; and at tree 35, 21.5%. Tree 83 was resprayed, because very little oil was delivered with the apparatus at the first attempt on account of the petroleum being low in the reservoir. The above figures vary much more widely than those of any tests previously made with this apparatus, and their divergence may have been due to the pump being somewhat out of order, though the precise trouble was not located.

The next day it began to rain about 10 a. m. and ceased about noon, beginning again at 1 p. m., and poured from about 1.30 to 2 p. m., but it did not cease raining till 3 p. m. On the 9th it rained some during the night and drizzled or rained most of the time between 8 a. m. and noon. It rained some most of the afternoon and during the night, and on the 10th it rained from 11 a. m. to 3 p. m., also during the night and on the nights of the 11th and 12th. The weather bureau records at the Albany station, less than 3 miles from the experimental orchard, give the precipitation as follows: .01 in. on the 7th; .22 on the 8th, .35 on the 9th and .20 on the 10th, a total of .78 in. or practically one third of the rainfall during the month on the day of and the three following the application.

An examination of the trees sprayed with oil showed that they were apparently well covered, and the smell of petroleum was very marked in the orchard. The rough bark on some of the trees seemed to have absorbed the oil pretty thoroughly, but on the smooth bark there was an abundance, as very little or none had evaporated. The oil remaining on the trees for so long a period with comparatively little evaporation was most favorable to injury if such would be produced, and consequently a number of the trees were examined closely May 6, with the following

results. Tree 113 was in very full bloom, showing that the fruit buds had suffered no injury. Tree 114 had a number of open blossoms and many unfolding buds. The latter had been seriously injured by the scale in earlier years and was recovering very nicely [pl. 2]. Tree 47 had many blossoms on it, though they were somewhat sparse, while 41 produced a very large number. Tree 101 bore a considerable number of opening blossoms. Trees 17-19 showed a slight blistering on the smooth bark, due probably to the application of crude petroleum, but, so far as could be discovered, no appreciable injury had been done. It should also be stated that the bloom of peachtrees in general was not full, so that a scarcity on the sprayed trees was not necessarily due to the insecticide used [pl. 5].

An examination June 12 showed that the petroleum was still apparent on the trees, but signs of its presence were limited very largely to a darker, more moist appearance of the bark. There was very little or no odor of the oil in the orchard.

An examination June 20 showed that tree 28 bore some living females, and that young were found under the scales in small numbers. Tree 73 was very badly infested with young scales last spring, and these had been mostly destroyed. Living females were found only on the underside of the branches, in places where they were badly incrustated. The bark of this tree had cracked to some extent, probably owing to the oil. Trees 23 and 60 had some living scales, and the bark of each was very rough. Tree 103 was in excellent condition and had made a very satisfactory growth, for in 1900 it was very badly infested, and now the bark on the lower limbs and trunk is very rough. Tree 101 has a poor shape, owing to the death of limbs, resulting in all probability from the application of undiluted crude petroleum in 1900, but it is now making a fine growth. It has thrown out many suckers, which is due probably to its previous hard treatment. The bark of the lower limbs and trunk is very rough.

A detailed examination of these trees was made July 5 with the following results. There were few or no young on the following trees, 17, 19, 24, 26, 27, 34, 35, 42, 45, 46, 60, 62, 63, 64, 66, 70, 71, 74, 80, 81, 87, 88, 89, 90, 91, 101, 102, 103, 104, 109, 110, 111, 112, 113; there were few or very few young on the

following trees, 18, 25, 36, 37, 38, 40, 41, 43, 47, 65, 79, 82, 83, 84, 85, 105, 106, 108; young were rather abundant on trees 15, 16, 21, 22, 23, 28, 44, 61, 68, 69, 114; and young were very abundant on tree 73.

These trees were again carefully inspected Nov. 11 by my assistant, Mr Walker, who rated them as follows. Condition good, trees 15, 16, 17, 18, 19, 24, 25, 26, 27, 34, 35, 36, 37, 42, 43, 44, 45, 47, 60, 61, 62, 63, 64, 65, 66, 68, 71, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 101, 102, 103, 104, 105, 106, 109, 110, 111, 112, 113, and 114. The following were classed as being in a bad condition, that is having on them a number of living scale insects, trees 21, 22, 23, 38, 40, 41, 69, 70, 108; and trees 28 and 73 were rated as being very bad.

It will be seen by the above that only two trees were in very bad shape at the end of the season, and both of these were badly infested when the spraying was done last spring. Many of those classed as being in bad condition have the bark of the larger limbs and trunk rough, and this interferes materially with the efficiency of the insecticide. A comparison of the condition of these 70 trees with the 50 at the other end of the orchard sprayed with lime, salt and sulfur mixture is quite marked and emphatically in favor of treatment with the oil. It should be stated however that the relative inefficiency of the lime, salt and sulfur mixture was probably due to the rains following so shortly after application and continuing so long [see page 132]. These had practically no effect on the oil and therefore gave it the advantage.

The writer at the outset raised the question as to the possibility of injury resulting to trees which had been sprayed with petroleum for successive seasons, and now he is in a position to supply a little data on this question. Trees 25-28, 41-47 and 101-14 have received applications of crude petroleum for three successive seasons. Tree 101, a seckel pear, was very badly infested in 1900 when it was sprayed with undiluted petroleum and sustained serious injuries. The following year it was sprayed with a mechanical mixture, consisting of 15% oil and a whale oil soap solution, 1 pound to 4 gallons. Last spring it was sprayed with the 20% mechanical emulsion. This tree was in very bad condition at the outset, and, as above noted, was

seriously injured by the first application. It has been steadily improving and now is in a vigorous condition, has developed a large amount of new wood and bids fair in another year or two to have a symmetric, good sized head. The twigs made a growth of 8 to 12 inches during 1902 [pl. 3]. Tree 114, a pear of the same variety, was sprayed in 1900 with undiluted crude petroleum but was not injured so much as no. 101. It was treated last year with 20% mechanical crude petroleum, which was obtained from Titusville, and this year again with a 20% petroleum emulsion. It is in vigorous condition and much better off than two years ago [pl. 2]. Tree 69, a Howell pear, was treated in 1900 with whale oil soap and petroleum and with a mechanical emulsion of the latter in 1901 and 1902, and is now flourishing [pl. 3]. The same is practically true of tree 66, a Bartlett pear [pl. 2]. Tree 25 is a Beurre Bosc pear, which was very badly infested in 1900. Trees 26 and 27 are Kieffer and tree 28 a seckel pear; the latter was also very badly infested in 1900. At the end of 1900 young were reported as abundant on tree 28, and the same was true at the end of 1901. The very bad condition of the tree at the end of 1902 is probably due to the fact that it is in a corner which was rather difficult of access, and this may have had some influence on its treatment in earlier years. Tree 41 is a Crawford peach, and trees 42-45 and 47 are Old Mixon peachtrees. Trees 42 and 43 were very badly infested in the spring of 1900, but since then have developed little scale, and all are in as good, if not better, condition than two years ago last spring, and several of them bore very fair crops of fruit this year [pl. 5].

These cases go far toward showing that successive applications of crude petroleum, if carefully made, will not injure trees, and that those which are very badly infested can be freed from the scale to a considerable extent and brought into a profitable bearing condition.

Experiments at Highland. A 20% mechanical crude petroleum emulsion was applied Ap. 1 to 52 plumtrees, mostly Abundance and a few Burbank. The trees had been covered with ice and snow by a storm during the night and had just dried. The weather at the time of spraying was sunny, rather cool, and considerable wind was stirring, but the trees were well covered with

the insecticide. Samples of the emulsion taken near the beginning, the middle and end of the spraying gave respectively 17%, 13.6% and 15.6% of oil. These samples were taken while spraying under a reduced pressure and from both nozzles. This variation is greater than any recorded in previous years and may have been due to the apparatus being somewhat out of order. Sunday, the 6th, $\frac{7}{8}$ inch of rain fell, and between that and the 11th, $1\frac{3}{4}$ inches more. The weather was such that no spraying was attempted between the initial application and the latter date.

An examination July 7 showed that about all of the trees sprayed with the emulsion were infested with from very few to rather abundant young scale insects. They were found almost entirely near the center of the rows. There was no evidence to show that the fruit buds had been affected in the slightest by the application.

An examination Nov. 25 showed that the trees were in very good condition. There were a few living scales on every one, and in a few cases they might be classed as somewhat abundant, but in no instance were there enough to interfere with the health of the tree. The general results were very satisfactory. All of the treated trees were in very thrifty condition and bore immense numbers of fruit buds.

Experiments at Warwick. About 50 old peachtrees were sprayed with 20% crude petroleum emulsion on Mar. 25, which was a bright, sunshiny day, though in the afternoon there was some wind. The trees in this old orchard are from three to five or seven years of age, some of them being 15 feet high. Two rows of small, three year old peachtrees, about 60 in number, on a hill, were also sprayed on the same day for the special purpose of ascertaining the effect of the insecticide on the fruit buds. The wind blew some, and practically all of the trees were well covered with the insecticide. Samples of the emulsion were taken at the beginning, middle and end of the spraying in the old orchard and gave respectively 21%, 36% and 32% of oil. This variation must have been due to the taking of the samples from one nozzle and under a lower pressure than that employed in most of the spraying. Another sample taken in the middle of the spraying of the two rows of young trees on the hill gave but 14% of oil.

An examination July 8 showed that the trees near the northern end of the old orchard have very little or no scale, except in one instance. In this case the tree was very badly infested, the bark was quite rough, and the living young were very abundant. Quite a number of the treated trees bore considerable fruit. The trees in the young orchard showed very little or no injury except in a very few cases where possibly an excessive amount of oil was applied. A very few living scales were found on some of the trees and none on many.

An examination Nov. 24 did not give satisfactory results in the old orchard, since some of the trees were comparatively free from living insects, while others were rather abundantly infested. The latter, however, were trees with very rough bark, which probably had considerable to do with the insects escaping destruction. The condition of the trees in the young orchard on the hill was much more satisfactory, and there were very few scale insects to be found on those sprayed with the oil. The trees did not show the slightest injury, except in one or two instances, and this may have been due to other causes, since they had made an excellent growth during the summer and had developed numerous fruit buds.

Summer spraying. The application of even a mechanical crude petroleum emulsion to trees in full foliage has not been recommended in the past, and the writer does not feel justified in doing so at present, in spite of the fact that his attention was called last summer to a very badly infested peach orchard in the southern part of the State, which had been sprayed while in full leaf with 20% and 25% mechanical crude petroleum emulsion. The applications were made at this time because it had just been discovered that the orchard in question was very badly infested with the San José scale, and it was felt that even heroic measures should be resorted to in order to check the pest. The spraying was done July 7, and the following day many of the trees were literally dripping with the oil, and the same was true of the weeds underneath, though we failed to note any injury. This work was done on the recommendation of Mr P. L. Huested, San José scale inspector of the State Department of Agriculture, and this gentleman reports that, so far as he has been able to discover, the trees have not suffered from this treatment, except that con-

siderable foliage dropped from parts where it was thickest and evaporation presumably much slower. This was particularly true where the 25% emulsion was freely used.

Good's whale oil soap no. 3. About 35 peachtrees in the old peach orchard at Warwick were sprayed with this substance, using 2 pounds to the gallon. The application was made on Mar. 24 and 25, and the weather was bright and sunny, and there was practically no breeze while the spraying was in progress. No rain fell till Friday afternoon, the 28th, when it commenced to drizzle, and it poured during the night.

An examination of these trees July 8 showed that there were very few living young on those near the northern end of the orchard. There were perhaps a few more scale insects than on those treated with the lime, salt and sulfur mixture. The setting of the fruit was apparently unaffected by the application. A number of young trees in the young orchard on the hill, sprayed by Mr Williams with this substance, using $1\frac{1}{4}$ pounds to the gallon, had a few scales, while many were perfectly free. The application was hardly as effective as the crude petroleum. Some unsprayed trees on the eastern side of this small orchard had from a few to many scales, while there were very few or none on most. It should be stated that the San José scale does not appear to have thriven in the orchards where the experiments were conducted, and consequently the results are not so decisive as might be wished.

An examination Nov. 24 failed to give anything decisive in the old orchard, where conditions, so far as experimental work was concerned, were far from satisfactory. The trees, generally speaking, were in better shape than those sprayed with the crude petroleum, and in nearly as good condition as those treated with lime, salt and sulfur. The most marked results were observed in the young orchard on the hill, where a large number of the trees, as previously stated, were sprayed last spring with $1\frac{1}{4}$ pounds of soap per gallon. These trees were not, generally speaking, as free from the scale as the young trees which had been sprayed with the mechanical crude petroleum emulsion, but none of them were seriously infested, and a great many were comparatively free from living insects. There was a striking difference to be observed between these and others which were

not treated. The latter were in some cases very badly infested, having entire limbs nearly incrustated with thrifty scale insects.

Lime, salt and sulfur mixture. This compound was applied to about 50 trees in the eastern end of our experimental orchard; and the results obtained from this test differ somewhat from those in other parts of the State under somewhat different conditions. The following formula was used: 10 pounds of lime and 20 pounds of sulfur were thoroughly boiled in 20 gallons of water for one and one half hours, or till the sulfur was dissolved, which was indicated by the solution assuming an amber color. This mixture was stirred frequently during the boiling, and then 30 pounds of lime, which had previously been thoroughly slaked by pouring hot water over it, and in which 15 pounds of salt had been dissolved by stirring, was added to the boiling lime and sulfur mixture. The whole of this mixture was cooked half an hour, being thoroughly stirred from time to time, and then enough water was added to make 60 gallons. The mixture was thoroughly strained through gunny sacks and sprayed as soon as possible, so as to apply it when hot. The mixture used in the experiments under consideration was boiled very thoroughly, and there can be no question as to its having been properly prepared.

Trees 4-14, 29-33, 49-59, 75-78 and 92-100 were treated with this preparation, as well as 20 to 25 large plumtrees in an old orchard just north of the experimental plot. The work was completed about 5 o'clock in the afternoon, and no rain was observed to fall till about 10 o'clock of the following day. There was however very little drying of the spray, since the atmosphere was humid most of the time. The exact record of precipitation is given above under the 20% mechanical emulsion, p. 132.

An examination of these trees Ap. 11 showed that, while they were apparently well covered with the mixture, in reality the rain had washed the finer portions against the rougher projections on the bark and had also caused it to gather in masses on the smooth bark of the limbs. It is very probable that much of the more soluble material had been carried away, or deposited in spots here and there on the tree, much to the detriment of the application.

An examination of the treated trees May 6 showed that the signs so visible on the previous inspection had nearly disappeared. The only indication of the presence of the insecticide was a somewhat bluish color, except in the case of one or two trees, where the lime, salt and sulfur solution appeared to have lodged in masses and gave the trunk a somewhat speckled condition. Tree 4 produced a large number of flowers [pl. 4], and 95 had a very fair bloom.

An examination of a few trees June 20 showed that there were many living young on the underside of the limbs of tree 14. There were some living scales to be found in some positions on tree 13, and living females were abundant on the underside of the limbs of tree 12.

A detailed examination of the trees was made July 5 with the following results. There were few or no young on trees 4, 5, 6, 8, 31, 50, 55, 56, 57, 58, 76, 96, 97, 98, 99; there were few young on trees 10, 13, 32, 33, 49, 51, 59, 92; young were rather few on trees 29, 30, 52, 77 and 100; they were rather abundant on trees 7, 11, 14, 53, 78, 95; and they were very abundant on tree 12.

Examination of these trees Nov. 6 by my assistant, Mr Walker, led him to rate them as follows. He found live females and young on trees 4 and 5 and dead young on number 6; numbers 7-14 inclusive were in very bad condition; the same was true of 29-33 and of 49-53, 55-59, 76-78 and 95-98. The status of tree 54 was doubtful, and 93 and 94 had been removed. No living scale was found on tree 92.

This is quite different from the other end of the orchard, and it was so marked that it was comparatively easy to distinguish between those treated with the lime, salt and sulfur and those with crude petroleum, simply by the number of scale insects on them. It should be pointed out however that this test was an unusually severe one; and, while these facts tend to throw considerable doubt on the value of this material, they do not condemn it. It is possible that the lime, salt and sulfur mixture will prove to be one of our most valuable methods of controlling this scale insect, since Mr L. L. Morrell, of Kinderhook, who used the material under the writer's directions, obtained most satisfactory results, and reports from others have

been equally good. It will require more than one season's work to determine the exact status of this material in New York State, and at present we can only advise its use in a provisional manner.

Experiments at Highland. A number of young plumtrees, 13 Abundance and 13 Burbank, were sprayed Ap. 1 with the lime, salt and sulfur mixture prepared according to the formula given above. Some trouble occurred in this case, because the boiler was small and would not hold 10 gallons at once. It was therefore impossible to add all the lime and salt and boil for half an hour. The matter was further complicated by the boiler leaking after a part of the lime and salt had been added and boiled perhaps for 25 minutes. The whole had to be removed, placed in a barrel, the additional lime and salt added, and then to that was added considerable hot water, and the mixture covered and allowed to remain undisturbed perhaps an hour in the hope that the heat would complete the chemical action. The trees sprayed with this mixture were completely dry. The day was sunny and rather cool with considerable wind. All of the trees were sparsely infested with San José scale. No rain fell till the 6th, when there was a precipitation of $\frac{7}{8}$ inch, and from then to the 11th an additional $1\frac{3}{4}$ inches fell. The weather was such that no spraying had been possible since the first treatment.

An examination of the sprayed trees July 7 showed that there were very few living young, and that the mixture was apparent on the trees only as slightly white particles, which rendered the detection of the white, young scale insects very difficult. The application has undoubtedly killed a large proportion of the insects. Some other trees sprayed with lime, salt and sulfur, said to have been prepared according to the same formula but boiled only about half as long, were examined. The insecticide was much more apparent on the latter, and possibly it was more effective. In neither case did the mixture injure the fruit buds.

An examination Nov. 25 showed that the experimental trees were in excellent condition and, if anything, perhaps a little freer from the scale than those treated under similar conditions with the 20% mechanical petroleum emulsion. The trees above the experimental row were also sprayed later with lime, salt and sulfur mixture, which was boiled for a relatively short time, and considerable of the mixture was still to be seen on the northeast

side of the trunks and also on the underside of the larger branches. The condition of these trees was nearly as satisfactory as those of the experimental row sprayed by the writer.

A large number of trees below the experimental rows were also sprayed later with the lime, salt and sulfur mixture, which had been boiled till the amber color was very apparent, and the application was fully as thorough, according to the statement of the owner. A considerably larger number of living scale insects occurred on these lower rows, which may possibly be due to the fact that these trees were somewhat more infested in the spring; though this hardly seems an adequate explanation for the difference.

The extended breeding period of the San José scale was strikingly illustrated by finding a few living young and a great many in the white stage at the late date of Nov. 25. All the treated trees were then in a very thrifty condition and bore immense numbers of fruit buds.

Experiments at Warwick. The same mixture was applied Mar. 24 and 25 to some old peachtrees in the town of Warwick, Orange co. The mixture was prepared according to directions given above, and, owing to its not being very thick on some trees, a number were resprayed the second day. The applications in both instances were made on bright, rather sunshiny days, though there was some wind in the afternoon. Rain commenced to fall in a slight drizzle Friday afternoon, the 28th, and during the night it rained very hard. An examination the following morning showed that very little of the mixture had been washed off.

An examination of these trees July 8 showed little that was decisive. A few scales were living, and the same was true of untreated trees, and therefore no definite conclusions could be drawn. Fruit buds appeared not to have been affected by the application, and the trees did not seem to be harmed in the slightest.

An examination Nov. 24 failed to give anything decisive with this material. The trees sprayed with this substance were in as good condition as those treated with the crude petroleum or the whale oil soap solution, but the difference was not marked enough to warrant the drawing of any conclusions unless it be that the

lime, salt and sulfur proved fully as effective as the other insecticides under these unsatisfactory conditions.

The results obtained with the lime, salt and sulfur mixture seem to indicate that, in order to be effective, the wash must not be exposed to drenching rains within three or four days after application. The exceedingly poor results following the application in the vicinity of Albany apparently show that this material is nearly worthless if the application be followed immediately by considerable rain. This instance certainly raises a strong doubt as to the value of this material when applied under such conditions. Should subsequent experiments prove this to be true, it will nearly disqualify this wash for use in our eastern climate, since such periods of immunity from rain can not be depended on in early spring, and the same is true to a lesser extent in the fall and during the winter.

Summary

Our experience during the past three years and that of many others with spring applications of crude petroleum emulsion has been so uniformly satisfactory that we are at loss to account for the poor results obtained by others. The many injuries to fruit trees and the dangerous nature of the material emphasize the necessity of caution and the grower, who would use crude petroleum is therefore advised to experiment on a small scale at first. The fall treatment came so near injuring the trees that we can not advise it. The application of this material in successive years has not caused the injury we feared but on the contrary the trees have grown rapidly and gained in vigor.

The whale oil soap is a valuable insecticide, particularly when applied in the fall though in doing this there is danger of injuring peach buds. A spring application, using only $1\frac{1}{4}$ lb to the gallon, if thorough, is a very effective check.

Our experience with lime, salt and sulfur has not been entirely satisfactory but the many excellent reports from other experimenters lead us to believe that possibly our results may have been exceptional and that this mixture may prove a most excellent material for controlling this scale insect, a point which can be determined only by further experimentation. It is, however, very disagreeable to handle, being hard on operator and apparatus.

VOLUNTARY ENTOMOLOGIC SERVICE OF NEW YORK STATE

The work of the last three years has been continued, and a number of observations have been added to previous records. The exceedingly unfavorable season, as noted on the preceding page, has interfered with the reception of the usual number of reports. Thirty voluntary observers were appointed during the season, and but 19 of them rendered reports. This is largely due to the general scarcity of injurious insects, which led a number of observers to conclude that there was comparatively little worthy of record. It will be noted that the following reports contain a considerable number of negative statements. These are of value as emphasizing observations on the marked scarcity of different species. The almost universal comments on cold, unseasonable weather seem to warrant the conclusion that the relative absence of insect life was due to adverse climatic conditions.

Summaries of reports from voluntary observers

The scientific names, or other matter, inserted in brackets indicate determinations or information supplied by the entomologist, and the other names are presumably correct except where questioned. The date given after the record is that of the writing of the record, except in a few instances where this was absent, and the date of reception was inserted. The latter is from one to two days later than that of the original record.

Cattaraugus county (C. E. Eldredge, Leon)—Appletree tent caterpillars [*Clisiocampa americana* Fabr.] appeared May 23, and the appletree bark louse [*Mytilaspis pomorum* Bouché] is quite abundant on some trees. A few years ago bumblebees were very abundant in this section, but now we seldom see them. May 28. Colorado potato beetles [*Doryphora 10-lineata* Say] appeared May 31. The looper caterpillar has been very abundant on beech and mapletrees. A few specimens of the cottony mapletree scale insect [*Pulvinaria innumerabilis* Rathv.] have appeared on maples, and another scale (*Lecanium ? quercitrionis*) was found on ironwood leaves that had withered on the branch. A specimen of the larva of *Notolophus ? antiqua* Linn. was found on

an appletree. Cankerworms have also appeared. June 11. The cottony mapletree scale insect has increased largely in numbers in the last few weeks. Colorado potato beetles are doing very little damage this summer. This is probably due to the excessive wet weather, which has also prevented grasshopper eggs from hatching. Only three or four nests of the appletree tent caterpillar have been met with. Flies are quite numerous on cattle [probably the horn fly ? *Haematobia serrata* Robs. Desv.], and the wet weather does not seem to affect them much. The codling moth [*Carpocapsa pomonella* Linn.] has damaged the apple crop to quite an extent. July 22. Fall webworms [*Hyphantria textor* Harris] appeared on our apple and forest trees the last week of July. Grasshoppers are quite abundant in some sections, and squash bugs are not as numerous as last year. The excessive wet weather has prevented serious injuries by grasshoppers, though they have worked on heads of grain to a considerable extent. Aug. 12.

Chemung county (M. H. Beckwith, Elmira)—The currant sawfly [*Pteronus ribesii* Scop.] appeared on gooseberries May 2, though not in such large numbers as usual. Appletree tent-caterpillars [*Clisiocampa americana* Fabr.] are very abundant again this season. Colorado potato beetles [*Doryphora 10-lineata* Say] are not found in any numbers at the present date. The excessively cold weather appears to be holding insects in check to a great extent. May 28. The second brood of the currant sawfly has appeared on the leaves, though it is not usually found till the fruit is nearly ripe. Cutworms are very abundant in tobacco fields and are necessitating a large amount of resetting of plants where they have been destroyed. June 16. Potato beetles are not so abundant as last year, and the larvae or grubs appear to have been held in check by the unusually cold, wet weather. The same appears to have been true of most of our destructive insects, though grasshoppers are quite numerous in meadows and pastures. July 17.

Dutchess county (H. D. Lewis, Annandale)—Injurious insects have been unusually scarce up to date. Colorado potato beetles [*Doryphora 10-lineata* Say] are present in small numbers, and no elm leaf beetles [*Galerucella luteola* Müll.] have

been observed where in former years trees were defoliated by them. Though the forest tent caterpillars [*Clisiocampa disstria* Hübn.] have been numerous, they have not been so abundant as last year, and they are now in the pupa or cocoon stage. Some maples have been badly defoliated by this pest. June 20. Aside from the forest tent caterpillar, we have been remarkably free from insect pests. These caterpillars have inflicted considerable damage on hard maples, our principal shade trees. June 23. A few elm leaf beetles have made their appearance, though but little damage has been caused. The extremely wet weather has kept insects pretty well in check. Potato beetles have been scarce and easily controlled. July 18.

Erie county (J. U. Metz, Swormville)—Asparagus beetles [*Crioceris asparagi* Linn.] have been exceedingly numerous this spring and much more abundant than in former years. No currant worms [*Pteronus ribesii* Scop.] have appeared so far and few potato beetles. A very little Hessian fly [*Cecidomyia destructor* Say] has been observed in a neighboring wheat field. May 28. Hessian fly has been found only in very small numbers; probably less than 1% of wheat is infested. There appears to be no more of this pest on no. 6 wheat than on more resistant varieties. The bud moth [*Metocera ocellana* Schiff.] is scarce, and no indications of the palmer worm [*Ypsolophus pometellus* Harr.] have been observed. Not a single nest of the apple-tree tent caterpillar [*Clisiocampa americana* Fabr.] has been found. June 20.

Genesee county (J. F. Rose, South Byron)—The first asparagus beetle [*Crioceris asparagi* Linn.] was observed May 25, and the currant sawfly [*Pteronus ribesii* Scop.] had lopped young currant shoots by May 23. There is a little complaint of potato beetles [*Doryphora 10-lineata* Say] working on tomatoes. No injury by Hessian fly [*Cecidomyia destructor* Say] has been reported, and apple-tree tent caterpillars [*Clisiocampa americana* Fabr.] do not appear to be as abundant as last year. Currant worms are rarer. May 26. Apple-tree tent caterpillars are certainly much less numerous than last year. There are not nearly so many to be seen along the roadsides, and their scarcity in these places is attributed to the

mice girdling most of the wild cherries the previous winter. The young caterpillars, therefore, had nothing to feed on and died. May beetles [*Lachnosterna* species] are very numerous in the soil. June 2. Potato beetles are very abundant on early potatoes. But little damage has as yet been reported from the Hessian fly. There does not appear to be one apple tree tent caterpillar this year where there were a hundred last year. The weather has been very cool and dry. The bud moth [*Metocera ocellana* Schiff.] has been very abundant and is apparently becoming more numerous each year. It is one of our worst fruit pests. June 10. Striped cucumber beetles [*Diabrotica vittata* Fabr.] were first observed June 14. There are yet no reports of injuries by the Hessian fly, and not a tree has been seen that was troubled by the forest tent caterpillar [*Clisiocampa disstria* Hübn.], even where the pest was abundant last year. June 16. The black squash bug, or stink bug [*Anasa tristis* DeGeer], appeared June 21. They are few as compared with the striped cucumber beetle. The very wet, cold weather appears to have delayed the appearance of many insect pests, including the Hessian fly. Even the white wheat, no. 6, that was so badly injured last year, is comparatively free from damage the present season. June 25. The first nests of the fall webworm [*Hyphantria textor* Harris] were observed July 22, and the spotted grapevine beetle [*Pelidnota punctata* Linn.] and the squash vine borer [*Melittia satyriniformis* Hübn.] had also appeared by that time. The striped cucumber beetle and the squash bug are much less abundant than last year. The green cabbage worms [*Pieris rapae* Linn.] are becoming quite numerous. Mosquitos were very scarce in this vicinity till last week. The Colorado potato beetle [*Doryphora 10-lineata* Say] has been as bad, if not worse, than ever before in some sections. Many growers have been obliged to resort to power sprayers in order to control the pest. July 28. The fall webworm is by far the most abundant I have ever seen it. A hairy caterpillar [*Datana integerrima* Gr. & Rob.] has defoliated some of the butternut and black walnut trees in this section. The squash bug is much less abundant than it has been for a number of years. Sep. 1.

Greene county (O. Q. Flint, Athens)—The forest tent caterpillar [*Clisiocampa disstria* Hübn.] appears to be carrying its destructive work eastward, leaving infested territory after two to four years' depredations. June 25.

Herkimer county (George S. Graves, Newport)—The currant sawfly [*Pteron us ribesii* Scop.] was observed on bushes May 23 and had evidently been feeding for about a week. Pistol case-bearers [*Coleophora malivorella* Riley] are abundant in some orchards, while the appletree tent caterpillar [*Clisiocampa americana* Fabr.] is relatively scarce as yet. The currant aphid [*Myzus ribis* Linn.] is not very plentiful, though it appeared shortly after the currant leaves. Bumblebees are very abundant this season. May 29. The Colorado potato beetle [*Doryphora 10-lineata* Say] appeared May 31, and farmers report it as being unusually abundant. Plantain leaves have been eaten by the same insect [probably *Dibolia borealis* Chev.], as for the last three years. The striped cucumber beetle [*Diabrotica vittata* Fabr.] was recently found on potato vines in my garden, and a neighbor reports a large number of them on his potatoes. The larvae of the elm flea beetle [*Disonycha triangularis* Say] appears to be quite injurious to elms throughout this section, and signs of their work were observed in the city of Utica. Grasshoppers are not very abundant as yet. June 12. The spiny elm caterpillar [*Euvanesa antiopa* Linn.] has been feeding on alders to a considerable extent. The eggs of the praying mantis [*Mantis religiosa* Linn.] appear to be hatching. June 22. The first grubs of the Colorado potato beetle were observed June 23. The forest tent caterpillar [*Clisiocampa disstria* Hübn.] is extremely rare, but one larva having been observed this year, though it is reported as being very abundant at Gravesville, 7 miles north. Grasshoppers are not numerous. The cold weather seems to have checked the development of many insects. The spiny elm caterpillars are devouring the foliage of wayside bushes. June 27. Rose beetles [*Macrodactylus subspinosus* Fabr.] have been and are still very destructive to plants in the local cemetery. Besides depredating on hydrangeas and rosebushes, they have nearly defoliated a large Virginia creeper and are now working on the lower leaves of a large elm tree.

They have also attacked geraniums in the cemetery and later cherry and plum trees to some extent. The foliage of one raspberry bush has been nearly destroyed by these pests. July 4. Rose beetles have been exceedingly destructive in this section and seem to attack almost everything in the vegetable line this season. The black headed cabbage worm [*Evergestis stramenalis* Hübn.] is causing much damage to turnips. Currant worms have again made their appearance and seem to be a fourth brood. Horn flies [*Haematobia serrata* Rob.-Desv.] are not so abundant as usual. Grasshoppers are eating potato vines seriously, while the Colorado potato beetle is somewhat scarce. July 21. Spittle insects were noticed on a small butternut tree in the woods July 17. Horn flies have been plentiful for about a week, and the large horseflies, usually so common during haying time, are just appearing, Aug. 1. The first nest of the fall webworm [*Hyphantria textor* Harris] was noticed on cherry Aug. 1. Rose beetles, though they have been very destructive to nearly every plant, have not eaten the small plants as they did last year. Caterpillars of the cabbage butterfly [*Pieris rapae* Linn.] have begun their depredations. Rainy weather continues to keep many destructive insects in check. Aug. 2. Caterpillars of the cabbage butterfly are more abundant than I have ever known them, while the adult insects are correspondingly scarce, having been seldom seen about the garden. Aug. 18. Cabbage butterflies were very numerous Aug. 21, and currant worms were noticed within a week on currant bushes. Sep. 16.

Livingston county (W. R. Houston, Geneseo)—Four lined leaf bugs [*Poecilocapsus lineatus* Fabr.] are now working on currants. This week has been very cold, and the temperature is between 36° and 40°, with snow flurries. May 28. Market gardeners in this vicinity are complaining of injuries by the cabbage root maggot [*Phorbia brassicae* Bouché], and they are afraid that the crop will be a short one. There was a heavy white frost on the 9th. Colorado potato beetles [*Doryphora 10-lineata* Say] are few, and so far no eggs have hatched. June 12.

Ontario county (J. J. Barden, Stanley)—Cutworms are very abundant and are doing a great deal of damage in newly set

cabbage fields. One farmer reports a loss of 6000 plants on three acres. The complaint is very general in this section. June 20. A webworm [*Tetralopha*] is very abundant on maple, elm and other forest trees in the vicinity of Dansville, though not so numerous as last year. Sep. 20.

Orange county (J. M. Dolph, Port Jervis)—Very few injurious insects have appeared this year. Even plant lice are relatively scarce; and the appletree tent caterpillar [*Clisiocampa americana* Fabr.] has almost entirely disappeared. There has been comparative freedom from insect pests this year, which may possibly be attributed to the cold, wet weather. The average temperature in this section for July and August 1901 was 74.2° while the average for the same months this year was 69.2°, a decrease during the past season of 5°. Sep. 3.

Queens county (C. L. Allen, Floral Park)—Colorado potato beetles [*Doryphora 10-lineata* Say] have been conspicuous by their absence, and not one farmer in ten has had occasion to use paris green for the purpose of controlling them. Not a cabbage worm [*Pieris rapae* Linn.] has been seen. The heavy rains of April killed all the butterflies, and now we see only one or two. The season has been marked by an almost entire absence of the more common insect pests. Oct. 3.

Rensselaer county (W. C. Hitchcock, Pittstown)—The appletree tent caterpillars [*Clisiocampa americana* Fabr.] are abundant and very destructive, since the foliage is backward and their ravages are more apparent. They do not seem to have been injured in the slightest by the late frost. Plum curculio [*Conotrachelus nenuphar* Herbst.] pupae are unusually abundant in the soil about the trees. May 23. Asparagus beetles [*Crioceris asparagi* Linn.] are abundant. Apples are nearly all dropping on account of the worms. [Probably the codling moth larva, *Carpocapsa pomonella* Linn.] Aug. 13. One mantis [*Mantis religiosa* Linn.] was found nearly grown on Sep. 28, and a neighbor who saw it stated that she had observed several of them. Sep. 30.

Rockland county (S. B. Husted, Blauvelt)—The corn worm [*Chelymormpha argus* Licht.] appears to be doing considerable damage. The fall webworm [*Hyphantria textor* Harris] is quite plentiful in this section. Colorado potato beetles

[*Doryphora 10-lineata* Say] have not been so abundant as in former years, which is probably due to the cooler season. Plum curculios [*Conotrachelus nenuphar* Herbst.] are plenty, but not so prevalent as during some seasons. July 12.

Schoharie county (John F. Johnson, Breakabeen)—Currant worms [*Pteronous ribesii* Scop.] appeared May 20 and are quite abundant and destructive. The grubs of the May or June beetle are also numerous and somewhat injurious. No forest tent caterpillars [*Clisiocampa disstria* Hübn.] have been observed this season, and those belonging to the appletree species [*Clisiocampa americana* Fabr.] are spinning their cocoons. May 30. Colorado potato beetles [*Doryphora 10-lineata* Say] appeared about June 1 and are quite abundant. A very few forest tent caterpillars were observed and they are now spinning their cocoons. June 15.

Suffolk county (Alexander Mair, Oakdale)—There are very few Colorado potato beetles [*Doryphora 10-lineata* Say] in Suffolk county this year. Locusts [*? Cicada septendecim* Linn.] are abundant, but appear to be doing no special injury. The San José scale [*Aspidiotus perniciosus* Comst.] is very bad in this section, and comparatively little is being done toward its control. There are too many remedies and faith in none. June 23.

Tompkins county (C. E. Chapman, Peruville)—Forest tent caterpillars [*Clisiocampa disstria* Hübn.] have damaged a few maple and apple trees. The striped cucumber beetle [*Diabrotica vittata* Fabr.] is present in marked numbers, and the Colorado potato beetles [*Doryphora 10-lineata* Say] are scarce for this time of year. Flea beetles [*? Epitrix cucumeris* Harris] are very abundant, completely riddling potatoes, red raspberries and other foliage. June 30. Cabbage worms [*Pieris rapae* Linn.] are abundant and easily killed with paris green and water. Potato beetles are not numerous, though white grubs are plenty in potato fields and newly set strawberry beds. There is an abundance of young grasshoppers. July 30.

Ulster county (George S. Clark, Milton)—Some plant lice [*? Myzus cerasi* Fabr.] have appeared on cherrytrees and the appletree tent caterpillar [*Clisiocampa americana* Fabr.]

has done considerable damage in this section. There are hundreds of its nests in defoliated wild cherry and appletrees. May 30. The grape leaf curler [probably the grapevine plume moth, *Oxyptilus periscelidactylus* Fitch] appeared May 25. Appletree tent caterpillars are very abundant and are making their cocoons in large numbers. There are very few leaf hoppers [? *Typhlocyba*] on grapes. Plant lice are increasing in numbers, and thrips are abundant on rosebushes. June 15. Comparatively few insects are causing injury at the present time. The black flea beetle [*Epitrix cucumeris* Harris] is doing considerable damage to tomato and potato vines. June 13. Nests of the fall webworm [*Hyphantria textor* Harris] have begun to appear, and there are a few plant lice on cherry-trees. July 3. The second brood of currant worms [*Pteronuss ribesii* Scop.] has appeared on some unsprayed bushes. Fall webworms are increasing in numbers, and they can be seen in many trees. Colorado potato beetles [*Doryphora 10-lineata* Say] are causing some injury, though they are not very numerous. July 10. Leaf hoppers are very scarce on grapevines and rosebushes. The continuous wet, cold weather appears to have kept them in check. Only a few fall webworms are to be seen at the present time. July 31. Fall webworms are still present but not nearly so abundant as last year, there being not over one nest to 25 of last season. There are some cabbage worms [*Pieris rapae* Linn.], but, as cabbage is little grown in this section, not much damage has been done. Aug. 27.

Warren county (C. L. Williams, Glens Falls)—Strawberry sawflies [*Monostegia ignota* Nort.] are feeding to some extent on strawberry plants. June 5. There are no insects in this region causing special trouble. July 29.

Wyoming county (W. H. Roeper, Wyoming)—Cankerworms made their appearance May 22 and have caused very little damage as yet. Appletree tent caterpillars [*Clisiocampa americana* Fabr.] are scarce, and very few of the forest species [*Clisiocampa disstria* Hübn.] have been found. May 26. The weather has been cold and wet since Saturday, and there was a white frost Sunday night. This unseasonable weather appears to have kept insects pretty well in check, and there is comparatively little to report. June 10.

FAUNAL STUDIES

A detailed study of the distribution of insects in New York State, or, for that matter, in any section where there is some variety in climate and physical characteristics, is bound to result in some interesting discoveries regarding the factors limiting the presence of various species. This is a matter of considerable importance, since it has a practical application in enabling us to determine in a measure the limits beyond which some of our very destructive, introduced species can not spread. The collection of my assistant, Mr Young, listed below, has been made in an exceptionally rich locality, where there is more or less mingling of boreal and austral forms. Over 700 species are represented in the list, to which we expect large additions will be made in the future. It is published at this time, not only to make the data available, but also in the hopes that other entomologists in that locality may be encouraged to continue the work.

LIST OF COLEOPTERA TAKEN AT NEWPORT, HERKIMER CO. N. Y.

BY D. B. YOUNG

We have had lists from the western and southeastern parts of the State of New York and the Adirondacks, but none so far, to our knowledge, from the central portion of the State. The object of this list is threefold: partially to fill the gap, to call the attention of collectors and others to a much neglected field, and to show the result of five years' continuous collecting in a single restricted locality, restricted in that this section is almost destitute of pine, spruce, balsam and oak. Therefore, it will be noticed that many of the forms found about these trees, only a day's drive to the north, are absent from this list.

Our thanks are due to Mr Charles Liebeck of Philadelphia Pa. for his kindness in determining quite a large number of the beetles.

COLEOPTERA.

- Cicindela 6-guttata Fabr.*
C. purpurea Oliv.
C. vulgaris Say
C. repanda Dej.
Omophron tessellatum Say
Cychnus brevoorti Lec.
C. lecontei Dej.
Carabus maeander Fisch.
C. limbatus Say
Calosoma scrutator Fabr.
C. frigidum Kirby
C. calidum Fabr.
Elaphrus ruscarius Say
Dyschirius sp.
Clivina impressifrons Lec.
Schizogenius amphibius Hald.
Bembidium inaequale Say
B. nigrum Say
B. ustulatum Linn.
B. picipes Kirby
B. variegatum Say
B. intermedium Kirby
B. versicolor Lec.
B. quadrimaculatum Linn.
Tachys laevus Say
T. nanus Gyll.
T. flavicauda Say
T. tripunctatus Say
Patrobus longicornis Say
Pterostichus adoxus Say
P. rostratus Neum.
P. honestus Say
P. lucublandus Say
Amara fallax Lec.
A. interstitialis Dej.
A. obesa Say
Dicaelus elongatus Bon.
Calathus gregarius Say
Platynus hypolithus Say
P. angustatus Dej.
P. sinuatus Dej.
P. melanarius Dej.
P. cupripennis Say
P. placidus Say
P. ruficornis Lec.
P. picipennis Kirby
Galerita janus Fabr.
Lebia grandis Hentz.
L. ornata Say
Lebia fuscata Dej.
L. scapularis Dej.
Apristus cordicollis Leo.
Cymindis pilosa Say
Brachynus fumans Fabr.
B. cordicollis Dej.
Chlaenius sericeus Forst.
C. tricolor Dej.
C. pennsylvanicus Say
Brachylobus lithophilus Say
Geopinus incrassatus Dej.
Agonoderus pallipes Fabr.
A. partiaris Say
A. pauperculus Dej.
A. testaceus Dej.
Harpalus viridiaeneus Beauv.
H. caliginosus Fabr.
H. pennsylvanicus De G.
H. var. erythropus Dej.
H. herbivagus Say
Bradycellus rupestris Say
Anisodactylus nigerrimus Dej.
A. verticalis Lec.
Haliplus ruficollis De G.
Cnemidotus 12-punctatus Say
C. edentulus Lec.
Laccophilus maculosus Germ.
Bidessus affinis Say
Coelambus punctatus Say
Hydroporus modestus Aubé
Ilybius biguttatus Germ.
Copelatus glypticus Say
Agabus obtusatus Say
Rhantus binotatus Harris
Colymbetes sculptilis Harris
Dytiscus fasciventris Say
D. verticalis Say
Acilius semisulcatus Aubé
A. fraternus Harris
Gyrinus ventralis Kirby
Dineutes assimilis Aubé
Helophorus lineatus Say
Hydrochus excavatus Lec.
H. subcupreus Rand.
Hydrophilus triangularis Say
H. nimbatus Say
H. glaber Herbst
Hydrocharis obtusatus Say
Berosus striatus Say

Laccobius agilis *Rand.*
Philhydrus ochraceus *Melsh.*
Hydrocombis fimbriatus *Melsh.*
Hydrobius globosus *Say*
H. fuscipes *Linn.*
H. digestus *Lec.*
Sphaeridium scarabaeoides *Linn.*
Cercyon praetextatum *Say*
C. unipunctatum *Linn.*
Cryptopleurum vagans *Lec.*
Necrophorus orbicollis *Say*
N. marginatus *Fabr.*
N. pustulatus *Hersch.*
N. vespilloides *Herbst*
N. tomentosus *Web.*
Silpha surinamensis *Fabr.*
S. lapponica *Herbst*
S. inaequalis *Fabr.*
S. noveboracensis *Forst.*
S. americana *Linn.*
Choleva luridipennis *Mann.*
C. simplex *Say*
C. clavicornis *Lec.*
C. terminans *Lec.*
Prionochaeta opaca *Say*
Anisotoma collaris *Lec.*
Colenis impunctata *Lec.*
Liodes globosa *Lec.*
L. basalis *Lec.*
Agathidium oniscoides *Beauv.*
A. politum *Lec.*
Tmesiphorus carinatus *Say*
Tyrus humeralis *Aubé*
Falagria cingulata *Lec.*
Aleochara lata *Grav.*
A. bimaculata *Grav.*
Gyrophaena affinis *Fauv.*
Quedius fulgidus *Fabr.*
Q. capucinus *Grav.*
Listotrophus cingulatus *Grav.*
L. capitatus *Bland.*
Creophilus villosus *Grav.*
Staphylinus maculosus *Grav.*
S. violaceus *Grav.*
Ocypus ater *Grav.*
Philonthus aeneus *Rossi*
P. lomatus *Er.*
P. brunneus *Grav.*
P. cyanipennis *Fabr.*
P. blandus *Grav.*

Actobius sobrinus *Er.*
A. paederoides *Lec.*
A. terminalis *Lec.*
Xantholinus cephalus *Say*
Leptolinus rubripennis *Lec.*
Stenus bipunctatus *Er.*
S. junio *Fabr.*
S. stygicus *Say*
S. parallelus *Casey*
S. flavicornis *Er.*
S. canadensis *Casey*
S. punctatus *Er.*
Cryptobium bicolor *Grav.*
C. pallipes *Grav.*
Lathrobium punctulatum *Lec.*
L. bicolor *Lec.*
L. collare *Er.*
Paederus littorarius *Grav.*
Sunius longiusculus *Mann.*
Tachinus memnonius *Grav.*
T. addendus *Horn*
T. flavipennis *Dej.*
T. fimbriatus *Grav.*
T. picipes *Er.*
T. limbatus *Melsh.*
Tachyporus maculipennis *Lec.*
T. jocosus *Say*
T. chrysomelinus *Linn.*
Conosoma littoreum *Linn.*
C. crassum *Grav.*
C. pubescens *Payk.*
C. basale *Er.*
C. scriptum *Horn*
Boletobius niger *Grav.*
B. cingulatus *Mann.*
B. cincticollis *Say*
B. anticus *Horn*
B. trinotatus *Er.*
B. cinctus *Grav.*
B. quaesitor *Horn*
Mycetoporus americanus *Er.*
Oxytelus femoralis *Grav.*
O. lateralis *Grav.*
O. 5-maculatus *Lec.*
Oxytelus sculptus *Grav.*
O. rugosus *Grav.*
O. fuscipennis *Mann.*
Anthobium convexum *Fauv.*
Glyptoma costale *Er.*
Siagonium punctatum *Lec.*

Actidium *sp.*
Ptenidium *sp.*
Trichopteryx haldemanni *Lec.*
Scaphidium quadriguttatum *Say*
Scaphisoma convexum *Say*
Olibrus consimilis *Marsh*
Sacium fasciatum *Say*
Megilla maculata *De G.*
Hippodamia glacialis *Fabr.*
H. convergens *Guér.*
H. 13-punctata *Linn.*
H. parenthesis *Say*
Coccinella trifasciata *Linn.*
C. 9-notata *Herbst*
C. transversoguttata *Fabr.*
C. var. californica *Mann.*
C. sanguinea *Linn.*
Adalia bipunctata *Linn.*
Anatis 15-punctata *Oliv.*
Psyllobora 20-maculata *Say*
Chilocorus bivulnerus *Muls.*
Brachyacantha ursina *Fabr.*
B. var. 10-pustulata *Melsh.*
B. 4-punctata *Melsh.*
Hyperaspis undulata *Say*
H. signata *Oliv.*
Scymnus collaris *Melsh.*
S. tenebrosus *Muls.*
Rhanis unicolor *Ziegl.*
Phymaphora pulchella *Newm.*
Aphorista vittata *Fabr.*
Mycetina perpulchra *Newm.*
Endomychus biguttatus *Say*
Languria mozardi *Lat.*
L. gracilis *Newm.*
Dacne maculata *Say*
Megalodacne fasciata *Fabr.*
M. heros *Say*
Mycotretus sanguinipennis *Say*
M. pulchra *Say*
Tritoma festiva *Lec.*
T. macra *Lec.*
T. thoracica *Say*
Synchita fuliginosa *Melsh.*
Ditoma quadriguttata *Say*
Cerylon castaneum *Say*
Philothermus glabriculus *Lec.*
Rhyssodes exaratus *Ill.*
Silvanus surinamensis *Linn.*
S. bidentatus *Fabr.*

Silvanus imbellis *Lec.*
S. advena *Wall.*
Catogenus rufus *Fabr.*
Cucujus clavipes *Fabr.*
Laemophlaeus biguttatus *Say*
L. fasciatus *Melsh.*
L. modestus *Say*
L. convexulus *Lec.*
L. adustus *Lec.*
L. testaceus *Fabr.*
Dendrophagus glaber *Lec.*
Uliota dubius *Fabr.*
Atomaria ochracea *Zimm.*
A. ehippiata *Zimm.*
Ephistemus apicalis *Lec.*
Mycetophagus punctatus *Say*
M. flexuosus *Say*
M. bipustulatus *Melsh.*
M. pluripunctatus *Lec.*
M. obsoletus *Melsh.*
Tryphyllus humeralis *Kirby*
Typhoea fumata *Linn.*
Byturus unicolor *Say*
Dermestes caninus *Germ.*
D. lardarius *Linn.*
D. vulpinus *Fabr.*
Attagenus piceus *Oliv.*
Trogoderma ornatum *Say*
T. tarsale *Melsh.*
Anthrenus scrophulariae *Linn.*
A. varius *Fabr.*
A. musaeorum *Linn.*
Hister interruptus *Beaur.*
H. americanus *Payk.*
H. lecontei *Mars.*
H. gracilis *Lec.*
Epierus regularis *Beauv.*
Saprinus rotundatus *Kuq.*
S. assimilis *Payk.*
S. fraternus *Say*
S. patruelis *Lec.*
Plegaderus transversus *Say*
Bacanius punctiformis *Lec.*
Brachypterus urticae *Fabr.*
Cercus abdominalis *Er.*
C. pennatus *Murr.*
Carpophilus niger *Say*
C. brachypterus *Say*
Colastus truncatus *Rand.*
Conotelus obscurus *Er.*

Epuraea rufa Say
Nitidula bipustulata Linn.
N. rufipes Linn.
Phenolia grossa Fabr.
Omosita colon Linn.
Thalycra concolor Lec.
Perthalyera murrayi Horn
Orthopeplus quadricollis Horn
Cychramus adustus Er.
Cryptarcha ampla Er.
Ips quadriguttata Fabr.
I. sanguinolentus Oliv.
I. confluentus Say
I. vittatus Say
Rhizophagus dimidiatus Mann.
R. bipunctatus Say
R. remotus Lec.
Latridius minutus Linn.
Corticaria grossa Lec.
Tenebrioides corticalis Melsh.
T. castanea Melsh.
Peltis pippingskoeldi Mann.
Calitys scabra Thunb.
Grynocharis 4-lineata Melsh.
Thymalus fulgidus Er.
Bactridium ephippigerum Guér.
B. striolatum Reut.
B. cavicolle Horn
Cytilus sericeus Forst.
Heterocerus fatuus Kies.
Ptilodactyla serricollis Say
Ectopria nervosa Melsh.
Prionocyphon discoideus Say
Cyphon obscurus Guér.
C. collaris Guér.
C. variabilis Thunb.
Tharops ruficornis Say
Deltometopus amoenicornis Say
Dromaeolus cylindricollis Say
D. striatus Lec.
Fornax orchেসides Newm.
Microrrhagus humeralis Say
M. pectinatus Lec.
Epiphanis cornutus Esch.
Adelocera marmorata Fabr.
A. aurorata Lec.
A. brevicornis Lec.
Alaus oculatus Linn.
Cryptohypnus planatus Lec.
C. abbreviatus Say

Cryptohypnus bicolor Esch.
C. tumescens Lec.
C. pectoralis Say
C. var. inops Lec.
C. melsheimeri Horn
Elater hepaticus Melsh.
E. pedalis Germ.
E. nigricollis Herbst
E. linteus Say
E. vitiosus Lec.
E. semicinctus Rand.
E. obliquus Say
Drasterius elegans Fabr.
Agriotes mancus Say
A. fucosus Lec.
Dolopius lateralis Esch.
Melanotus castanipes Payk.
M. fissilis Say
M. communis Gyll.
Limonius plebejus Say
Campylus denticornis Kirby
Pityobius anguinus Lec.
Athous cucullatus Say
A. rufifrons Rand.
Sericosomus silaceus Say
Corymbites vernalis Hentz.
C. cylindriciformis Herbst
C. spinosus Lec.
C. sulcicollis Say
C. hamatus Say
C. hieroglyphicus Say
C. cruciatus Linn.
Asaphes decoloratus Say
A. memnonius Herbst
Throscus constrictor Say
T. convergens Horn
Dicera divaricata Say
D. obscura Fabr.
D. var. lurida Fabr.
Buprestis maculiventris Say
Melanophila longipes Say
M. fulvoguttata Harris
Anthaxia viridicornis Say
Chrysobothris femorata Fabr.
Agrilus ruficollis Fabr.
A. otiosus Say
A. bilineatus Web.
Agrilus politus Say
Brachys ovata Web.

- Brachys aerea* Melsh.
Calopteron reticulatum Fabr.
Celetes basalis Lec.
Caenia dimidiata Fabr.
Lopheros fraternus Rand.
Eros thoracicus Rand.
E. aurora Herbst
E. sculptilis Say
E. crenatus Germ.
Plateros canaliculatus Say
P. lictor Newm.
Polycclasis bifaria Say
Lucidota atra Fabr.
L. punctata Lec.
Ellychnia corrusca Linn.
Pyropyga fenestralis Melsh.
P. decipiens Harris
Pyraclomena lucifera Melsh.
Photinus ardens Lec.
P. scintillans Say
Photuris pennsylvanica De G.
Chauliognathus pennsylvanicus De G.
Podabrus tricoatus Say
P. rugulosus Lec.
P. basilaris Say
P. comes Lec.
P. punctatus Lec.
P. pattoni Lec.
Telephorus dentiger Lec.
T. excavatus Lec.
T. carolinus Fabr.
T. lineola Fabr.
T. scitulus Say
T. rectus Melsh.
T. pusillus Lec.
T. rotundicollis Say
T. tuberculatus Lec.
T. bilineatus Say
Ditemnus bidentatus Say
Malthodes arcifer Lec.
M. fuliginosus Lec.
Collops 4-maculatus Fabr.
Cymatodera bicolor Say
Clerus quadriguttatus Oliv.
Thaneroclerus sanguineus Say
Hydnocera longicollis Ziegl.
Necrobia violacea Linn.
Ptinus fur Linn.
P. quadrimaculatus Melsh.
Trypophytus sericeus Say
Ptilinus ruficornis Say
Endecatomo rugosus Rand.
Cupes concolor Westw.
C. capitata Fabr.
Cis fuscipes Mellié
Ennearthron thoracicornis Ziegl.
Ceracis sallei Mellié
Dorcus parallelus Say
Platycerus quercus Wel.
Ceruchus piceus Web.
Passalus cornutus Fabr.
Copris anaglypticus Say
Onthophagus hecate Pan.
Aegialia rufa Lec.
Ataenius gracilis Melsh.
A. cognatus Lec.
Dialytes striatulus Say
Aphodius fossor Linn.
A. fimetarius Linn.
A. granarius Linn.
A. inquinatus Herbst
A. stercorosus Melsh.
A. prodromus Brahm.
A. walshii Horn
Bolboceras lazarus Fabr.
Odontaeus cornigerus Melsh.
Geotrupes splendidus Fabr.
G. egeriei Germ.
G. balyi Jek.
Trox suberosus Fabr.
T. tuberculatus De G.
T. scaber Linn.
Dichelonycha elongata Fabr.
D. testacea Kirby
Serica vespertina Gyll.
S. sericea Ill.
Macroductylus subspinosus Fabr.
Lachnosterna fusca Fröhl.
Pelidnota punctata Linn.
Euphoria inda Linn.
Cremastochilus canaliculatus Kirby
Osmoderma eremicola Knoch.
O. scabra Beauv.
Trichius affinis Gory
T. viridulus Fabr.
Parandra brunnea Fabr.
Orthosoma brunneum Forst.
Prionus laticollis Drury
Tetropium cinnamopterum Kirby
Phymatodes variabilis Fabr.

Phymatodes infuscatus Lec.
P. dimidiatus Kirby
Callidium janthinum Lec.
Tylonotus bimaculatus Hald.
Molorchus himaculatus Say
Plagionotus speciosus Say
Neoclytus erythrocephalus Fabr.
Clytanthus ruricola Oliv.
Cyrtophorus verrucosus Oliv.
Euderces picipes Fabr.
Desmocerus palliatus Forst.
Encyclops caeruleus Say
Centrodora decolorata Harris
Pachyta monticola Rand.
Anthophilax malachiticus Lec.
A. attenuatus Hald.
Acmaeops directa Newm.
Gaurotes cyanipennis Say
Typocerus velutinus Oliv.
Leptura lineola Say
L. haematites Newm.
L. exigua Newm.
L. canadensis Fabr.
L. proxima Say
L. vittata Germ.
L. pubera Say
L. sphaericollis Say
L. vibex Newm.
L. aurata Horn.
L. mutabilis Newm.
Acanthoderes quadrigibbus Say
Leptostylus macula Say
Liopus alpha Say
Lepturges symmetricus Hald.
L. querci Fitch
Hyperplatys maculatus Hald.
Urographis fasciatus De G.
Pogonocherus mixtus Hald.
Saperda calcarata Say
S. vestita Say
S. tridentata Oliv.
Oberea bimaculata Oliv.
O. tripunctata Swed.
Tetraopes tetraophthalmus Forst.
Amphionycha flammata Newm.
Donacia rufa Lec.
Ornodachna atra Ahr.
Zeugophora varians Cr.
Syneta ferruginea Germ.
Lema trilineata Oliv.

Exema sp.
Bassaricus mammifer Newm.
Cryptocephalus quadruplex Newm.
C. var. 4-guttulus Suffr.
C. mutabilis Melsh.
Pachybrachys litigiosus Suffr.
P. trinotatus Melsh.
P. intricatus Suffr.
Monachus saponatus Fabr.
Diachus auratus Fabr.
Xanthonia 10-notata Say
X. villosula Melsh.
Chrysochus auratus Fabr.
Typophorus canellus Fabr.
T. var. aterrimus Oliv.
T. var. thoracicus Melsh.
T. var. 6-notatus Say
Graphops pubescens Melsh.
Nodonota brunnea Fabr.
N. tristis Oliv.
Prasocuris vittata Oliv.
Doryphora clivicollis Kirby
D. 10-lineata Say
Chrysomela similis Rog.
C. praecelsis Rog.
C. elegans Oliv.
C. scalaris Lec.
C. philadelphica Linn.
C. var. spiraeae Say
C. multipunctata Say
Plagioderia viridis Melsh.
Gastroidea polygona Linn.
Lina tremulae Fabr.
Cerotoma trifurcata Forst.
Phyllobrotica discoidea Fabr.
Luperus meraca Say
Diabrotica 12-punctata Oliv.
D. vittata Fabr.
D. longicornis Say
Trirhabda tomentosa Linn. var. cana-
densis Kirby
Galeruca decora Say
Oedionychis vians Ill.
O. quercata Fabr. var. limbalis Melsh.
Disonychia pennsylvanica Ill.
D. triangularis Say
D. xanthomelaena Dalm.
Haltica ignita Ill.
Crepidodera helxines Linn.
C. cucumeris Harris

- Orthaltica copalina Fabr.*
Systema hudsonias Forst.
S. marginalis Ill.
Phyllotreta vittata Fabr.
P. bipustulata Fabr.
P. chalybeipennis Cr.
Dibolia borealis Chev.
Psylliodes punctulata Melsh.
Odontota nervosa Panz.
Coptocycla aurichalcea Fabr.
Chelymorpha argus Licht.
Bruchus pisi Linn.
Phelopsis obcordata Kirby
Nyctobates pennsylvanica De G.
Iphthimus opacus Lec.
Upis ceramoides Linn.
Haplodrusus femoratus Fabr.
Scotobates calcaratus Fabr.
Xylopinus saperdioides Oliv.
Tenebrio molitor Linn.
T. tenebrioides Beauv.
Tribolium ferrugineum Fabr.
Uloma impressa Melsh.
Diaperis hydni Fabr.
Platydemus excavatum Say
P. ruficornis Sturm.
P. flavipes Fabr.
P. americanus Lap.
Bolethotherus bifurcus Fabr.
Bolethophagus corticola Say
B. depressus Rand.
Cistela sericea Say
Mycetochares binotata Say
M. nigerrima Casey
Capnochora fuliginosa Melsh.
Arthromacra aenea Say
Penthe obliquata Fabr.
P. pimelia Fabr.
Synchora punctata Newm.
Prothalia undata Lec.
Melandrya striata Say
Hypulus simulator Newm.
Dircaea liturata Lec.
Anisoxya glaucula Lec.
Eustrophus tomentosus Say
E. repandus Horn
Holostrophus bifasciatus Say
Hallomenus scapularis Melsh.
H. debilis Lec.
Orchesia castanea Melsh.
Orchesia gracilis Melsh.
Canifa pallipes Melsh.
Rhinosisimus viridiaeneus Rand
Asclera ruficollis Say
A. puncticollis Say
Anaspis nigra Hald.
A. flavipennis Hald.
A. rufa Say
Tomoxia bidentata Say
Mordella borealis Lec.
M. melaena Germ.
M. marginata Melsh.
Mordellistena biplagiata Helm.
M. atriceps Smith
M. comata Lec.
M. aspersa Melsh.
M. pustulata Melsh.
M. convicta Lec.
Corphyra newmani Lec.
C. lugubris Say
C. collaris Say
Notoxus anchora Say
Anthicus reiectus Lec.
Pyrochroa flabellata Fabr.
Schizotus cervicalis Newm.
Dendroides canadensis Lat.
D. concolor Newm.
Meloe angusticollis Say
Pomphopoea sayi Lec.
Hormorus undulatus Uhl.
Cyphomimus dorsalis Horn
Sitones hispidulus Germ.
S. flavescens Marsh
S. tibialis Herbst
Ithycerus noveboracensis Forst.
Apion rostrum Say
Phytonomus punctatus Fabr.
P. nigrirostris Fabr.
Hylobius confusus Kirby
Bagous obliquus Lec.
Magdalis barbata Say
M. pandura Say
M. armicollis Say
Anthonomus signatus Say
A. rufipennis Lec.
A. corvulus Lec.
A. crataegi Walsh
A. canus Lec.
Orchestes pallicornis Say
O. niger Horn

<i>Orchestes ephippiatus Say</i>	<i>Rhinoncus pyrrhopus Lec.</i>
<i>Piazorhinus scutellaris Say</i>	<i>Baris strenua Lec.</i>
<i>Gymnetron teter Fabr.</i>	<i>Aulobaris naso Lec.</i>
<i>Conotrachelus juglandis Lec.</i>	<i>Sphenophorus sculptilis Uhl.</i>
<i>C. nenuphar Herbst</i>	<i>Calandra granaria Linn.</i>
<i>C. anaglypticus Say</i>	<i>Cossonus platalea Say</i>
<i>Tyloderma aereum Say</i>	<i>Stenocelis brevis Boh.</i>
<i>Cryptorhynchus parochus Herbst</i>	<i>Monorthrum mali Fitch</i>
<i>Piazurus oculatus Say</i>	<i>Pityophthorus minutissimus Zimm.</i>
<i>Coeliodes curtus Say</i>	<i>Xyloterus bivittatus Kirby</i>
<i>Acoptus suturalis Lec.</i>	<i>X. politus Say</i>
<i>Ceutorhynchus affluens Dietz</i>	<i>Xyleborus obesus Lec.</i>
<i>C. sulcipennis Lec.</i>	<i>Hylesinus aculeatus Say</i>
<i>C. semirufus Lec.</i>	<i>H. opaculus Lec.</i>
<i>C. septentrionalis Gyll.</i>	<i>Eurymycter fasciatus Oliv.</i>
<i>Pelenomus sulcicollis Fabr.</i>	<i>Cratoparis lunatus Fabr.</i>

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the entomologist during the year 1902. 64 are given with the title,¹ place and time of publication and a summary of the contents of each. Volume and page number are separated by a colon, the first superior figure tells the column, and the second the exact place in the column in ninths; e. g. 66: 842⁷ means vol. 66, p. 842, column 2, beginning in the seventh ninth, i. e. about seven ninths of the way down.

Hackberry Gall (Country Gentleman, Oct. 17, 1901, 66:842⁷)

The gall of *Pachypsylla celtidis-mamma* Riley, from Greenwich R. I., is briefly described and the insect characterized.

Dying White Pines (Troy Budget, Oct. 27, 1901, p.12; *Argus* [Albany] Nov. 17, p.13)

An account of injuries to white pines in the Hudson river valley by *Tomicus calligraphus* Germ., and associated species.

Seventeen Year Cicada (Country Gentleman, Nov. 7, 1901, 66:902²)

Gives distribution of brood of *Cicada septendecim* Linn. to appear in 1902 and indorses advice to refrain from setting young trees or close pruning in sections where the insect is abundant.

Cigar Case-bearer (Country Gentleman, Nov. 7, 1901, 66:902²)

The cases are described and the habits of *Coleophora fletcherella* Frn. given.

¹Titles are given as published; and in some instances they have been changed or supplied by the editors of the various papers.

Katydid Eggs (Country Gentleman, Nov. 14, 1901, 66:922²³)

Identifies and describes the oviposition of *Microcentrum retinervis* Burm.

Scale Insects of Importance and List of the Species in New York State (N. Y. State Mus. Bul. 46. June 1901 [issued Nov. 15]. 94p., 15 plates [seven colored])

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San José Scale (Worcester [Mass.] Sunday Telegram, Nov. 17, 1901, p.7)

Summary account of *Aspidiotus perniciosus* Comst.

¹A general account and bibliography of each is given.

Aquatic Insects of the Adirondacks. A study conducted at the entomologic field station, Saranac Inn N. Y., under the direction of the state entomologist, by James G. Needham Ph.D. and Cornelius Betten M.A. (N. Y. State Mus. Bul. 47. Sep. 1901 [issued Nov. 18]. 234p. 36 plates [six colored])

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Entomology and Entomologists in New York State (Argus [Albany] Dec. 3, 1901, p.5)

Abstract of annual address delivered before the Entomological Society of Albany.

Slaking Lime (Country Gentleman, Jan. 2, 1902, 67:6th)

Slaking and kind of lime to be used for bordeaux mixture.

Elm Leaf Beetle (Troy Budget, Jan. 12, 1902, p.6; Argus [Albany] Feb. 2, p.12)

Injuries, distribution and means of controlling *Galerucella luteola* Müll. The work of the Laurel Hill Association of Stockbridge Mass. mentioned. Insects Injurious to Elm Trees (Commissioners of Fisheries, Game and Forest. 5th Rep't, 1900 [rec'd Jan. 16, 1902] p.351-79; separate, issued Mar. 17, 1902)

Directions are given for the use of insecticides and the following species are noticed briefly: Elm leaf beetle, *Galerucella luteola* Müll.; bag or basket worm, *Thyridopteryx ephemeraeformis* Haw.; fall web-worm, *Hyphantria cunea* Drury; spiny elm caterpillar, *Euvanessa antiopa* Linn., elm borer, *Saperda tridentata* Oliv. and elm bark louse, *Gossyparia ulmi* Geoff.

Two New Species of Ophion (Psyche, Feb. 1902, 9:307-8)

Technical descriptions of *Ophion arcuatum* and *O. appendiculatum*, n. sp.

Further Notes on Crude Petroleum and Other Insecticides (U. S. Dep't Agric. div. ent. Bul. 31. n. s. 1902. p. 49-51)

Results obtained with crude petroleum, whale oil soap, etc.

The Hessian Fly in New York State in 1901 (U. S. Dep't Agric. div. ent. Bul. 31. n. s. 1902. p. 22-24)

Prevalence, damage and observations on broods of *Cecidomyia destructor* Say.

Observations on Forest and Shade Tree Insects in New York State (U. S. Dep't Agric. div. ent. Bul. 31. n. s. 1902. p. 63-68)

Notes on the following: *Anisota senatoria* Abb. & Sm., *Cacoecia argyrospila* Walk., *Chalcophora virginienensis* Drury, *C. liberta* Germ., *Anomala lucicola* Fabr., *Monohammus scutellatus* Say, *M. titillator* Fabr., *M. confusor* Kirby, *Glyptocelis hirtus* Oliv. [*pubescens* Fabr.], *Pissodes strobi* Peck, *Magdalis lecontei* Horn, *M. alutacea* Lec., *Dendroctonus terebrans* Oliv., *Tomicus calligraphus* Germ., *T. cacographus* Lec., *T. pini* Say, *T. balsameus* Lec., *Xylotrechus sagittatus* Germ., *Galerucella luteola* Müll., *Clisiocampa disstria* Hübn., *Prionoxystus robiniae* Peck, *Lecanium nigrofasciatum* Perg., *Pseudococcus aceris* Geoff. [*Phenacoccus acericola* King], and *Chermes pinicorticis* Fitch.

Ladybugs and Carpet Beetles (Country Gentleman, Feb. 13, 1902, 67:133^u)

Two spotted ladybug, *Adalia bipunctata* Linn., is characterized, and the Buffalo carpet beetle, *Anthrenus scrophulariae* Linn., and the black carpet beetle, *Attagenus piceus* Oliv., are briefly described and remedial measures given.

Soft Scale on Fern (Country Gentleman, Feb. 13, 1902, 67:133^u)

Lecanium hesperidum Linn. is briefly described, and the use of Ivory soap, a 5 cent cake to 8 gallons of water, advised.

Report of the Committee on Insects of the Eastern New York Horticultural Society (Eastern N. Y. Hortic. Soc. Proc. 5th annual meeting, 1901 [issued Feb. 1902] p. 20-26)

Gipsy moth, *Porthetria dispar* Linn., fruit tree bark beetle, *Scolytus rugulosus* Ratz., palmer worm, *Ypsolophus pometellus* Harris, and the forest tent caterpillar, *Clisiocampa disstria* Hübn., were noticed in particular. The results obtained with kerosene, whale oil soaps and crude petroleum in various combinations are given briefly.

School Children and San José Scale (Worcester [Mass.] Evening Gazette, Feb. 17, 1902, p. 3)

Letter advising the enlistment of school children as aids in detecting the San José scale, *Aspidiotus perniciosus* Comst., about Worcester Mass.

Hickory Bark Borer (Livingston Democrat [Genesee N. Y.] Feb. 26, 1902, p. 3)

Injuries of *Scolytus 4-spinosus* Say in the Genesee valley, earlier outbreaks, natural history and remedies.

Forest Tent Caterpillar (Country Gentleman, Mar. 6, 1902, 67:196^a-97^a)

Remedial measures against *Clisiocampa disstria* Hübner.

Spraying for Cicada (Country Gentleman, Mar. 13, 1902, 67:219^a)

Spraying recently emerged cicadas, *Cicada septendecim* Linn., with a contact insecticide is advisable only in limited areas.

San José Scale Investigations (Country Gentleman, Mar. 13, 1902, 67:221^a)

Criticism of results on *Aspidiotus perniciosus* Comst., obtained by Professors Lowe and Parrott. See N.Y. Agric. Exp. Sta. Bul. 202.

Fumigation (Country Gentleman, Mar. 27, 1902, 67:262^a)

Value of hydrocyanic acid gas against bedbugs, *Acanthia lectularia* Linn., and hen lice.

Report on Insects for 1901, read before Eastern New York Horticultural Society Feb. 12, 1902 (Country Gentleman, Mar. 27, 1902, 67:265^a, 290^a-91^a, 308^a)

The following insects were noticed: giant swallowtail, *Heraclides cressphontes* Cram., cicada-killer, *Sphecius speciosus* Drury, Hessian fly, *Cecidomyia destructor* Say, squash bug, *Anasa tristis* DeGeer. The value of trap lanterns was commented on, and the results obtained by the use of various insecticides against the San José scale were given. The fruit tree bark beetle, *Scolytus rugulosus* Ratz., the hickory bark borer, *Scolytus 4-spinosus* Say, the roundheaded appletree borer, *Saperda candida* Fabr., the elm leaf beetle, *Galerucella luteola* Müll., the grapevine *Fidia*, *Fidia viticida* Walsh, the peach twig moth, *Anarsia lineatella* Zell., *Cenopsis diluticostana* Wlsm., and the carrot rust fly, *Psila rosae* Linn., were also noticed.

Bark Louse (Country Gentlemen, Ap. 10, 1902, 67:306^a)

Remedies for *Mytilaspis pomorum* Bouché.

White Scale (Country Gentleman, Ap. 17, 1902, 67:329^a)

Remedies for *Aspidiotus hederae* Vall.

Insect Enemies to Shade Trees (Col. State Board Hort. Rep't, 1901. 1902 [rec'd Ap. 22] 13:164-70)

Some general considerations in preventing insect depredations with brief notices of the following species: Gipsy moth, *Porthetria dispar* Linn., leopard moth, *Zeuzera pyrina* Linn., white marked tussock moth, *Notolophus leucostigma* Abb. & Sm., spiny elm caterpillar, *Euvanessa antiopa* Linn., locust borer, *Prionoxystus robiniae* Peck, poplar borer, *Saperda calcarata* Say, cottonwood leaf beetle, *Lina scripta* Fabr. and cottony mapletree scale insect, *Pulvinaria innumeralis* Rathv.

Tussock Moth (Country Gentleman, Ap. 24, 1902, 67:351^a)

Remedial measures are given for the white marked tussock moth, *Notolophus leucostigma* Abb. & Sm

Scale Insects (Country Gentleman, May 1, 1902, 67:370^u)

Remedial measures for *Chionaspis furfura* Fitch and *Aspidiotus perniciosus* Comst. from Dorchester Mass.

May Beetles (Country Gentleman, May 8, 1902, 67:390^u)

There is no practical method of protecting trees from *Lachnosterna fusca* Fröhl.

Bagworms (Country Gentleman, May 8, 1902, 67:390^u)

The winter retreats, containing from 532 to 1284 eggs, are described and remedies are given for *Thyridopteryx ephemeraeformis* Haw.

Grape Root Worm (Country Gentleman, May 15, 1902, 67:413^u)

General account of *Fidia viticida* Walsh in New York and a discussion of remedies.

Tent Caterpillars (Country Gentleman, May 15, 1902, 67:414^u)

Brief note of warning in regard to *Clisiocampa americana* Fabr. and *C. disstria* Hübn.

Insect Pests and Plant Diseases (N. Y. State Lib. Bul. 72. 1902. p.181-83)

General summary of earlier laws and review of those enacted in the United States in 1901.

Insects in New York (Country Gentleman, May 22, 1902, 67:434^u)

Summary of reports from voluntary observers.

Appletree Tent Caterpillar (Country Gentleman, May 22, 1902, 67:438^u-39)

Remedies are given for *Clisiocampa americana* Fabr. and the habits of the fall webworm, *Hyphantria cunea* Drury [textor Harris], are briefly described.

Onion Thrips (Country Gentleman, May 29, 1902, 67:451^u)

Injuries and remedies for *Thrips tabaci* Lind.

Insects in New York (Country Gentleman, May 29, 1902, 67:454^u)

Summary of reports from voluntary observers.

Elm Tree Bark Louse (Country Gentleman, June 5, 1902, 67:471^u)

The habits and remedies for *Gossyparia ulmi* Geoff. are given.

Insects in New York (Country Gentleman, June 5, 1902, 67:471^u)

Summary of reports from voluntary observers.

Hopvine Aphis (Country Gentleman, June 12, 1902, 67:490^u)

Life history and remedial measures for *Phorodon humuli* Schrank.

Owl Beetle (Country Gentleman, June 12, 1902, 67:490^u)

Description and habits of *Alaus oculatus* Linn.

Gartered Plume Moth (Country Gentleman, June 12, 1902, 67:491^u)

Life history and remedies for *Oxyptilus periscelidactylus* Fitch

Insects in New York (Country Gentleman, June 12, 1902, 67:499^m)

Summary of reports from voluntary observers.

Insects of New York (Country Gentleman, June 19, 1902, 67:519^m)

Summary of reports from voluntary observers.

Lined Spittle Hopper (Country Gentleman, June 26, 1902, 67:530^m)

The work of *Ptyelus* [*Philaenus*] *lineatus* Linn. on grass described, and *Aphrophora parallella* Say on hard pine mentioned.

Silver Tip (Country Gentleman, June 26, 1902, 67:531^m)

This may be the work of several insects: *Limothrips poaphagus* Comst., larvae of *Chlorops* and *Meromyza* or *Jassidae*.

Insects in New York (Country Gentleman, June 26, 1902, 67:539^m)

Summary of reports from voluntary observers.

Grapevine Root Worm (Country Gentleman, July 10, 1902, 67:574-75)

Cultivation will destroy a large proportion of the pupae of *Fidia viticida* Walsh.

Insects in New York (Country Gentleman, July 10, 1902, 67:579^m)

Summary of reports from voluntary observers.

[Directions for Collecting Mosquitos] (Argus [Albany] July 27, 1902, p.14; Waterloo Observer, July 25, 1902, p.1)

Request for specimens from all parts of the State with directions for collecting.

Spread of Elm Leaf Beetle (New York Farmer, Aug. 21, 1902, p.4)

Observations on spread of *Galerucella luteola* Müll. about Albany and its carriage by electric cars.

Aquatic Insects of the Saranac Region (Forest, Fish and Game Commission. 6th Rep't, 1901 [issued Aug. 1902] p.499-531, six colored plates)

The introduction briefly describes the investigations of the office and discusses the complexity and interrelations existing among aquatic forms, with a chapter on the value of insects as food for fish. The economic importance of the following orders as fish food is briefly treated: stone flies (Plecoptera), May flies (Ephemeroidea), dragon flies (Odonata), fish flies, dobson and others (Neuroptera), caddis flies (Trichoptera) and flies (Diptera). Brief notes from Dr Needham's report (Museum bulletin 47) are given on the species known to occur in the region, and most of the illustrations are taken from the same publication.

Injuries by Elm Leaf Beetle (Albany Evening Journal, Aug. 26, 1902, p.10)

Brief note calling attention to injuries by *Galerucella luteola* Müll.

San José Scale (Country Gentleman, Aug. 28, 1902, 67:711ⁿ)Remedies for *Aspidiotus perniciosus* Comst.**Elm Leaf Beetle [*Galerucella luteola* Müll.] in New York State (N. Y. State Mus. Bul. 57, Entomology 15, p.1-43, Spl. [revised edition of Museum bulletin 20, issued Aug. 27])**

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Hag Moth Caterpillar (Country Gentleman, Sep. 4, 1902, 67:730^m)The food habits and life history of *Phobetron pithecium* Abb. & Sm. are given.**17th Report of the State Entomologist on Injurious and Other Insects of the State of New York (N. Y. State Mus. Bul. 53. 1901. [Issued Sep. 12, 1902] p.699-925, 29fig. 6pl.)**

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Scale Insects of Importance (American Gardening, Sep. 13, 1902, 22:593-94)

Reprint of portions of Museum bulletin 46 on above group.

Asparagus Beetle (Country Gentleman, Oct. 2, 1902, 67:810)

Remedies for *Crioceris asparagi* Linn.

Report on Insects (N. Y. State Fruit-Growers Ass'n Rep't. 1902. 6th An. Rep't 1902. p.210-18)

Brief notes on the unusual occurrence of a number of southern species.

Report of the Committee on Insects (Eastern N. Y. Hort. Soc. 6th An. Rep't 1902. p.210-18)

Some general observations on the abundance of southern forms are given together with notes on the value of trap lanterns, and the results of recent experiments with various insecticides against San José scale. The injuries inflicted by various bark borers are briefly recorded, and the following insects are noticed: Hickory bark borer, *Scolytus 4-spinosus* Say; elm leaf beetle, *Galerucella luteola* Müll.; grapevine *Fidia*, *Fidia viticida* Walsh; forest tent caterpillar, *Clisiocampa dissidia* Hübn.; *Cenopsis diluticostana* Walsm.; carrot rust fly, *Psila rosae* Fabr.; rose scale insect, *Aulacaspis rosae* Sandb.; European praying mantis, *Mantis religiosa* Linn.

CONTRIBUTIONS TO COLLECTION OCT. 16, 1901-OCT. 15,
1902**Hymenoptera**

Eumenes fraternus Say, fraternal potter wasp, cells on small branch, May 10; from G. S. Graves, Newport N. Y.

Agapostemon radiatus Say, Oct. 8; from Mrs E. C. Anthony, Gouverneur N. Y.

Thalessa atrata Fabr., the black long-sting, June 17; from C. Horton, Albany N. Y.

Microgaster sp., cocoons, Nov. 11; from L. L. Woodford, Lyndonville N. Y.

Cratotechus sp., pupal cases on soft maple, July 27; from W. T. Ropes, Montclair N. J.

Tremex columba Linn., pigeon tremex, Aug. 30; from W. S. Evans, Newport N. Y.

Monostegia ignota Nort., strawberry sawfly, larvae on strawberry plants, June 2; from C. L. Williams, Glens Falls N. Y.

Eriocampoides limacina Retz., peartree slug, larva on cherry, Sep. 12; from Calvin Shaffer, Albany N. Y.

Coleoptera

Scolytus quadrispinosus Say, adults and larvae on hickory logs, January; from W. W. Wadsworth, Geneseo N. Y.

Cryptorhynchus lapathi Linn., willow snout beetle, on poplar and willow, July 18; from C. W. Stuart & Co., Newark N. Y. Same on willow, Aug. 28; from J. Jay Barden, Newark N. Y.

Pissodes strobi Peck, the white pine weevil, pupae and adults, Aug. 28; from Ernest H. Crosby, Rhinebeck N. Y.

Lixus concavus Say, rhubarb curculio, June 26; from H. H. Ballard, Pittsfield Mass.

Epicauta cinerea Forst., margined blister beetle on potatoes, July 14; from G. F. Bixby, Plattsburg N. Y.

Chelymormpha argus Licht., argus beetle, adults on corn, July 18; from S. B. Husted, Blauvelt N. Y.

Galerucella luteola Müll., elm leaf beetle, adults on elm, Ap. 25; from S. S. Vrooman, Schenectady N. Y.

Fidia viticida Walsh, grapevine root worm, larvae on grapevine, Ap. 24; from Westfield N. Y. Same, May 18; from **F. A. Morehouse**, Ripley N. Y.

Oberea bimaculata Oliv., raspberry cane-girdler, adult on raspberry, July 11; from Dr **C. C. Schuyler**, Plattsburg N. Y.

Saperda fayi Bland, larvae in crataegus, Ap. 17; from **M. F. Adams**, Buffalo N. Y.

Monohammus confusor Kirby, the sawyer, adults, July 3; from **Carlton Turner**, Worcester N. Y. Same on pine, Aug. 4; from **B. Middlebrook**, Albany N. Y.

Prionus laticollis Drury, broad-necked *Prionus*, larva and pupa, June 24; from **G. S. Graves**, Newport N. Y.

Orthosoma brunneum Forst., straight-bodied *Prionus*, July 30; from **James E. Barkley**, Grahamsville N. Y.

Pelidnota punctata Linn., spotted grapevine beetle, adult, Aug. 4; from **L. Emmet**, Albany N. Y.

Dicerca divaricata Say, divaricated Buprestid, July 30; from **James E. Barkley**, Grahamsville N. Y.

Wireworm, undetermined, infested with *Cordyceps acicularis*, Dec. 25; from **C. W. Nash**, Toronto Can.

Alaus oculatus, Linn., owl beetle, adult, June 3; from **C. P. S.**, Schenectady N. Y. Same June 18; from **B. D. Van Buren**, Olcott N. Y. Same July 30; from **James E. Barkley**, Grahamsville N. Y.

Attagenus piceus Oliv., black carpet beetle, larvae in flour warehouse, May 21; from **Julian Van Deusen**, Hudson N. Y.

Silvanus surinamensis Linn., saw-toothed grain beetle, adult on oats, Oct. 18; from Mr **Freer**, Albany N. Y.

Chilocorus bivulnerus Muls., twice-stabbed ladybug, adults on San José scale-infested tree, May 2; from **J. J. Hicks**, Jericho L. I. Same, pupa on apple, Aug. 23; from **W. L. Downing**, Oneida N. Y.

Diptera

Psila rosae Fabr., the carrot rust fly, larvae in celery roots, Dec. 30; from **James Granger**, Broadalbin N. Y.

Lasioptera vitis O.S., grapevine gall insect, larvae in galls on grape leaves and stem, June 16; from **J. Jay Barden**, Westfield N. Y.

Culex excrucians Walk. and *Anopheles punctipennis* Say, mosquitos, adults, July 25; from Percy L. Husted, Pine Island N. Y.

Rhabdophaga salicis Schrank, European willow gall midge, larvae on European willow, Ap. 15; from H. C. Peck, Rochester N. Y.

Lepidoptera

Euvanessa antiopa Linn., spiny elm caterpillar, larvae on willow, alder, June 22; from G. S. Graves, Newport N. Y. Same, on willow (*Salix discolor*), June 30; from C. B. Pettis, Saranac Junction N. Y.

Eurymus philodice Godt., clouded sulfur, adult, Oct. 22; from J. P. Van Ness, East Greenbush N. Y.

Heracleides crespontes Cram., giant swallowtail, July 15; from Henry Griggs, Newpaltz N. Y.

Hemaris diffinis Bdv., July 30; from James E. Barkley, Grahamsville N. Y.

Amphion nessus Cram., June 16; from J. F. Rose, South Byron N. Y.

Thyreus abbotii Swains., Abbot's sphinx, larvae on *Ampelopsis*, July 25; from W. B. Phipp, Delmar N. Y.

Philampelus pandorus Hübn., *pandorus* sphinx, larva on grape, May 30; from H. L. Griggs, Newpaltz N. Y.

Phlegethontius celeus Hübn., tomato worm, on tomato, Aug. 21; from C. H. Peck, Menands N. Y. Same, adult, Aug. 30; from Dr U. G. Williams, Newport N. Y.

Sphinx drupiferarum Abb. & Sm., plum sphinx, June 16; from J. Jay Barden, Westfield N. Y. Same, male and female, June 17; from J. H. Dodge, Rochester N. Y.

? *Paonias excaecatus* Abb. & Sm., blind-eyed sphinx, young larvae on oak, June 20; from Rhoda Thompson, Ballston Spa N. Y.

Arctia virgo Linn., July 30; from James E. Barkley, Grahamsville N. Y.

Pyrrharctia isabella Abb. & Sm., the black and red woolly bear, larvae, Oct. 22; from J. P. Van Ness, East Greenbush N. Y.

Notolophus antiqua Linn., larva on *Crataegus*, July 22; from G. S. Graves, Newport N. Y.

Phobetron pithecium Abb. & Sm., hag moth caterpillar, larva on maple, Aug. 26; through *Country Gentleman*, Westwood N. Y.

Thyridopteryx ephemeraeformis Haw., bagworm, bags on cedar, Jan. 24; from Dr M. W. Van Denburg, Mount Vernon N. Y. Eggs of same on yellow locust, Ap. 21; from J. J. Hicks, Jericho L. I. Eggs of same on plum, Ap. 28; from Weaverling & Biddle, Everett Pa. Same on arbor vitae, May 6; from Mrs E. H. Mairs, Dobbs Ferry N. Y.

Schizura concinna Abb. & Sm., red-humped appletree worm, larva on apple, Oct. 4; from Cyrus R. Crosby, Penn Yan N. Y.

Tropaea luna Linn., luna moth, adult, June 3; from J. H. McClure, Franklinville N. Y. Same; from James E. Barkley, Grahamsville N. Y.

Telea polyphemus Linn., polyphemus moth, Aug. 9; from B. Middlebrook, Albany N. Y.

Clisiocampa americana Fabr., appletree tent caterpillar, larva on appletree, May 11; from Lloyd Balderston, Coloma Md.

Xylophasia arctica Bdv., July 30; from James E. Barkley, Grahamsville N. Y.

Hydroecia species, larva on ginseng, July 30; from H. W. Elmendorf, Coeymans Hollow N. Y.

Euthisanotia grata Fabr., beautiful wood nymph, adult on hollyhock, June 30; from F. A. Fitch, Randolph N. Y. Same on Boston ivy, June 30; from Mrs E. C. Anthony, Gouverneur N. Y. Same, July 30; from James E. Barkley, Grahamsville N. Y. Same, Aug. 2; from G. S. Graves, Newport N. Y.

Heliothis armiger Hüb., the corn worm, larvae on corn, Aug. 25; from Dr M. W. Van Denburg, Mount Vernon N. Y.

Geometrid sp., larva on Crataegus, July 22; from G. S. Graves, Newport N. Y.

Pyralis costalis Fabr., clover hay caterpillar, larvae in timothy hay, Ap. 9; from George B. Kinney, Amenia N. Y.

? *Tetralopha* species, larvae on maple, Sep. 2; from E. H. Crosby, Rhinebeck N. Y.

Dioryctria abietella Shiff., larvae in spruce cones, Sep. 24; from C. R. Pettis, Fulton Chain N. Y.

Ephestia kuehniella Zell., Mediterranean flour moth, pupae in graham flour, Oct. 4; from Dr **M. W. Van Denburg**, Mount Vernon N. Y.

Oxyptilus periscelidactylus Fitch, gartered plume moth, larvae on grapevine, June 2; from **David Muirhead**, Staten Island N. Y. Same, June 10; from **Verplanck Colvin**, Albany N. Y.

Phoxopteris nubeculana Clem., apple leaf-folder, larvae on apple, Sep. 4; from **Charles V. Winne**, Albany.

Coleophora fletcherella Fern., cigar case-bearer, larvae, Nov. 1; from **F. D. A.**, Wings Station N. Y.

Coleophora limosipennella Dup., larvae on Scotch elm, July 18; from **Walter W. Hoover**, Brooklyn N. Y.

Bucculatrix canadensisella Chamb., birch *Bucculatrix*, larvae on birch, Sep. 16; from **C. H. Peck**, Lake Placid N. Y.

Aspidisca splendoriferella Clem., resplendent shield-bearer, cocoon on apple, January; through State Dep't Agric., Chautauqua county, N. Y.

Neuroptera

Chrysopa sp., lace-winged fly, adult, June 10; from **Verplanck Colvin**, Albany N. Y.

Corydalis cornuta Linn., horned corydalis, male, July 10; from **J. N. Wright**, Grand Gorge N. Y. Same, July 21; from **F. W. Vail**, Milton N. Y. Same, July 30; from **J. B. Boynton**, Altamont N. Y. Same, Aug. 1; from **C. A. Wieting**, Cobleskill N. Y. Same, Sep. 12; from **C. E. Chapman**, Peruville N. Y.

Hemiptera

Blissus leucopterus Say, chinch bug, adults on rye, June 18; from **Purley Minturn**, Locke N. Y.

Phymata wolffii Stal., ambush bug, adult on pear Sep. 1; from **J. F. Rose**, South Byron N. Y.

Stenopoda culiciformis Fabr., adult, August; from **H. H. Ballard**, Pittsfield Mass., from the South.

Typhlocyba comes var. *vitifex* Fitch, grapevine leaf-hopper, work on grape leaves, June 3; from **J. Jay Barden**, Westfield N. Y.

Philaenus lineatus Linn., lined spittle hopper, young on grass, June 18; from **L. L. Woodford**, Scriba N. Y.

Ceresa bubalus Fabr., Buffalo tree hopper, eggs in pear twig, Oct. 25; from **L. L. Woodford**, Waterport N. Y.

Chionaspis americana Johns., elm scale insect, adult females on elm, Jan. 16; from **J. Jay Barden**, Newark N. Y.

Chionaspis furfura Fitch, scurfy bark louse, eggs on apple, Jan. 6; from **C. H. Stewart**, Newark N. Y. Same, eggs on pear, Ap. 19; **O. F. R.**, Dorchester Mass. Same, on apple, Aug. 23; from **W. L. Downing**, Oneida N. Y. Same, on pear, Aug. 28; from **J. H. Dodge**, Olcott N. Y.

Mytilaspis pomorum Bouché, appletree bark louse, adults on apple, Mar. 29; from **E. B. Hequan**, Washington county, N. Y. Eggs of same on willow, May 23; from **S. T. Skidmore**, East Hampton N. Y.

Aulacaspis rosae Sandb., rose scale, adults and young on crimson rambler rose, Oct. 15; from **C. W. Calkins**, Cobleskill N. Y. Same, females on raspberry, Oct. 17; from **J. F. Mara**, Cornwall N. Y. Same, females on blackberry, Oct. 30; from **Chester Young**, New York city. Same, females on rose, Jan. 16; from **J. Jay Barden**, Stanley N. Y.

Chrysomphalus aonidum Linn., young females on rubber plant, Nov. 30; from **L. L. Woodford**, Lyndonville N. Y.

Diaspis pentagona Targ., West Indian peach scale, adult females on cherry, Jan. 23; from **Chester Young**, New York customhouse N. Y.

Aspidiotus ancylus Putn., Putnam's scale, adult, Oct. 18; from **H. C. Peck**, Rochester N. Y. Same, young females on Osage orange, Oct. 29; from **P. L. Heusted**, Coxsackie N. Y. Same, adult female on currant, Dec. 13; from **C. H. Darrow**, Geneva N. Y. ? Same, on ? *Acer pennsylvanicum*, Ap. 15; from **J. F. Rose**, South Byron N. Y. Same, females on Kieffer pear, May 12; from **B. D. Van Buren**, Albion N. Y. Same, young, second stage, on willow, May 12; from **Chester Young**, New York city.

Aspidiotus forbesi Johns., cherry scale insect, female on apple, Oct. 30; from **Chester Young**, Westchester Pa. ? Same, young, second stage, on peach, Ap. 2; from **P. L. Heusted**, Highland N. Y.

Aspidiotus hederæ Vallot, white scale insect of the ivy, adults on ivy, Mar. 29; from **J. Richards**, Sherborn Mass.

Aspidiotus ostreaeformis Curtis, European fruit tree scale insect, young females on plum, Oct. 25; from C. W. Cole, Irondequoit N. Y. Same, or *ancylus* Putn., second stage young on pear, Oct. 25; from C. W. Cole, Irondequoit N. Y. Same, young female on plum, Nov. 15; from L. L. Woodford, Lyndonville N. Y. Same, adult females, young, on lilac, Mar. 15; State Dep't Agric., Belgium, Europe. Same, adult female on plum, June 13; from B. D. Van Buren, Olcott N. Y.

Aspidiotus perniciosus Comst., San José scale, female on apple, Oct. 28; from B. D. Van Buren, Waterport N. Y. Same, adults and young, on willow, Mar. 27; from C. L. Allen, Floral Park L. I. Same, young females on apple, May 5; from J. F. Johnson, Breakabeen N. Y. Young of same on peach, May 22; from Louis F. Brown, Washingtonville N. Y. All stages of same on apple, Aug. 13; from Emily Thomas, Union Springs N. Y.

Lecanium nigrofasciatum Perg., adults on willow, Mar. 24; from J. J. Barden, Stanley N. Y.

Lecanium pruinatum Coq., frosted lecanium, eggs on American elm, May 30; from J. M. Southwick, Providence R. I.

Lecanium ? quercitrionis Fitch, adults on ironwood, June 11; from C. E. Eldridge, Leon N. Y.

Lecanium tulipiferae Cook, tuliptree scale, young on tuliptree, Jan. 20; from Mrs E. H. Mairs, Irvington N. Y.

Pulvinaria innumerabilis Rathv., cottony mapletree scale insect, adults on maples, June 11; from C. E. Eldredge, Leon N. Y. Same, on elm, July 27; from W. T. Ropes, Montclair N. J.

Eriopeltis sp., adults on grass, collected in August 1899; from C. O. Houghton, Stark N. Y.

Gossyparia ulmi Geoff., elm bark louse, adults on American elm, May 19; from O. Q. Flint, Athens N. Y. Same, females on elm, May 23; from J. M. Southwick, Providence R. I. Same, females on weeping elm, May 24; from T. C. M., New Dorp N. Y.

Pemphigus populicaulis Fitch, adults on poplar, June, 23; from W. B. Melius, Albany N. Y.

Phylloxera caryaecaulis Fitch, hickory gall aphid, galls on leaf stalks of hickory, June 16; from L. L. Woodford, Madison county. Same, few females and many young on hickory, June 17; from Dr F. W. Seward, Goshen N. Y.

Phylloxera vitifoliae Fitch, galls on Delaware grapevines, Sep. 4; from P. L. Heusted, Marlboro N. Y.

Schizoneura americana Riley, elm leaf aphid, adults on American elm, May 30; from J. M. Southwick, Providence R. I.

Orthoptera

Oecanthus angustipennis Fitch, adult, Sep. 22; from H. L. Griggs, Newpaltz N. Y.

? *Microcentrum retinervis* Burm., katydids, eggs on magnolia twig, Ap. 15; through State Dep't Agric., Rockland county. Same, eggs on apple, Nov. 4; from W. L. M., Augusta county, Va.

Diapheromera femorata Say, walking stick, Oct. 9; from L. L. Woodford, Berwyn N. Y.

Tenodera sinensis Sauss., Chinese praying mantis, eggs on imported Japanese maples, Ap. 12; from P. L. Husted, Blauvelt N. Y.

Acarina

Trombidium locustarum Riley, locust mite, half grown young on grasshopper, Sep. 17; from Henry L. Griggs, Newpaltz N. Y.

Myriapoda

Julus ? caeruleocinctus Wood., young on strawberries, June 24; from C. H. Peck, Menands N. Y.

Vermes

Gordius sp., hair worm on hair snake, coiled in knots in soil, May 12; from C. E. Eldredge, Leon N. Y.

EXPLANATION OF PLATES

PLATE 1¹

Brown tail moth

Euproctis chrysorrhoea Linn.

- 1 Egg mass on the underside of a pear leaf and also on twig
- 2 Young caterpillars or larvae as they appear in early spring
- 3 Half grown and full grown caterpillars
- 4 Pupae in portion of a web mass, also a few cast larval skins
- 5 Male moth at rest
- 6 Female moth with wings partly extended
- 7 Hibernating tents in which the winter is passed

PLATE 2

Tree 114 was sprayed with undiluted petroleum Ap. 11, 1900, and with a 20% mechanical petroleum emulsion in the spring of 1901 and of 1902. The first application undoubtedly injured the tree considerably, but under the later treatments it has been recovering, as is evidenced by the new twigs shown in the view taken Mar. 10 and the abundant bloom of May 6.

Tree 66 was treated with a combination of whale oil soap and crude petroleum in April 1900 and with 25% and 20% mechanical crude petroleum emulsion in the springs of 1901 and 1902 respectively. It was severely cut back in 1901, and the recent growth gives no indication of weakness.

PLATE 3

Tree 101 was sprayed with undiluted crude petroleum in April 1900 and severely injured. The following spring it was treated with a combination of whale oil soap and petroleum and in the spring of 1902 with a 20% mechanical emulsion. It has developed a large amount of vigorous new wood.

Tree 69 was treated with a combination of whale oil soap and crude petroleum in April 1900, and with 25% and 20% mechanical crude petroleum emulsion respectively in the spring of 1901 and 1902. The vigorous growth under this treatment is very apparent.

¹Executed from nature under the author's direction by L. H. Joutel.

PLATE 4

Tree 4 was sprayed with the lime, salt and sulfur mixture in the spring of 1902 with no indication of injury to the bloom.

Tree 113 was treated in April 1900 with a mixture of whale oil soap and crude petroleum and the two following springs with a 20% mechanical crude petroleum emulsion. There is no sign of injury, and the profuse bloom shows that the buds were not harmed.

PLATE 5

Trees 41 and 47 have been sprayed three springs in succession with a 20% mechanical crude petroleum emulsion, except that in the case of the former a 25 % emulsion was applied in 1901. Little or no injury has resulted, and the somewhat abundant bloom shows that the buds were not affected to any extent.

PLATE 6

1 Work of willow and poplar curculio, *Cryptorhynchus lapathi* Linn.

2 Nun moth, *Psilura monacha* Linn; slightly enlarged.

3 Birch leaf *Bucculatrix*, *Bucculatrix canadensisella* Chamb., *a*, skeletonized leaf; *b*, molting cocoon; *c*, larva; *d*, head of larva; *e*, anal segments of larva; *f*, same of pupa; *g*, cocoon with extruded pupal skin; *h*, moth — all enlarged. (From *Insect Life*)

1. The first of these is the

2. The second of these is the

3. The third of these is the

4. The fourth of these is the

5. The fifth of these is the

6. The sixth of these is the

7. The seventh of these is the

8. The eighth of these is the

9. The ninth of these is the

10. The tenth of these is the

11. The eleventh of these is the

12. The twelfth of these is the

13. The thirteenth of these is the

14. The fourteenth of these is the

15. The fifteenth of these is the

16. The sixteenth of these is the

17. The seventeenth of these is the

18. The eighteenth of these is the

19. The nineteenth of these is the

20. The twentieth of these is the

21. The twenty-first of these is the

22. The twenty-second of these is the

23. The twenty-third of these is the

24. The twenty-fourth of these is the

25. The twenty-fifth of these is the

26. The twenty-sixth of these is the

27. The twenty-seventh of these is the

28. The twenty-eighth of these is the

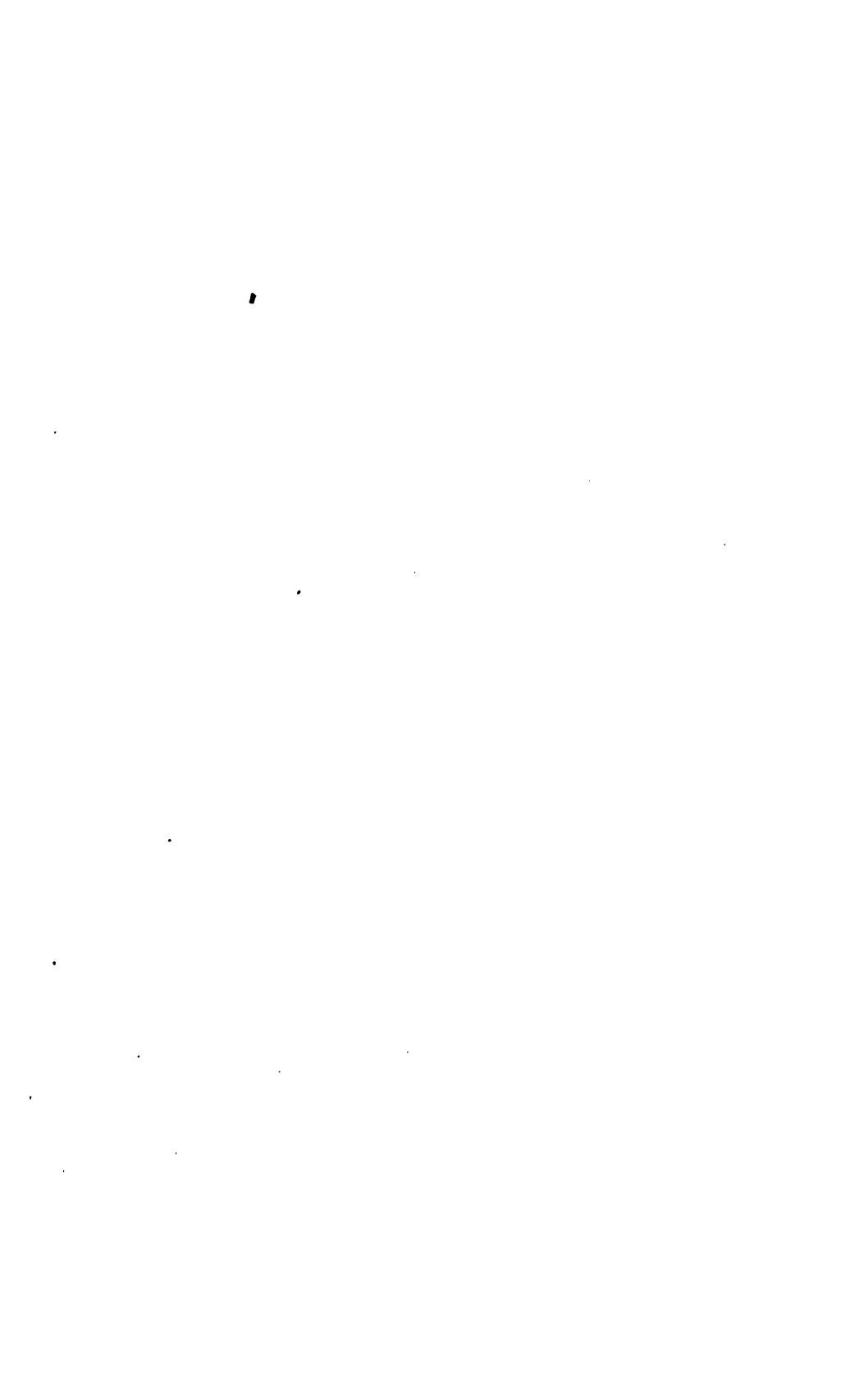
29. The twenty-ninth of these is the

30. The thirtieth of these is the



L. H. Joutel, 1902

Brown-tail moth





Tree 114

Seckel, pear

Photo March 10



Tree 114

Seckel pear

Photo May 6



Tree 66

Bartlett pear

Photo March 10

THREE YEARS OF CRUDE PETROLEUM



Tree 101

Seckel pear

Photo March 10



Tree 69

Howell pear

Photo March 10



Tree 4

Wild cherry

Photo May 6

LIME, SALT AND SULFUR, 1902



Tree 118

Beurre d'Anjou pear

Photo May 6

THREE YEARS OF CRUDE PETROLEUM



Tree 41

Crawford peach

Photo May 6



Tree 47

Old Mixon peach

Photo May 6

THREE YEARS OF CRUDE PETROLEUM



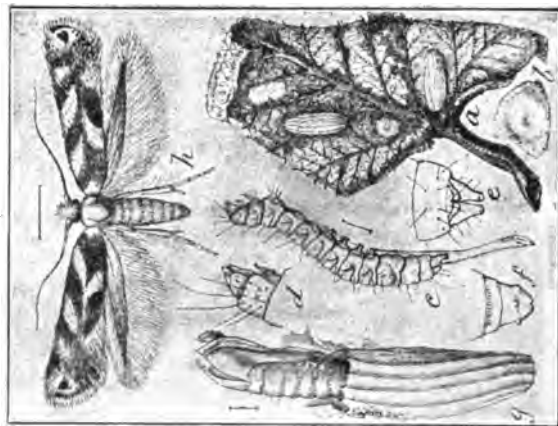


2



1

Willow and poplar curculio



Birch Bucculatrix⁸

Nun moth



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